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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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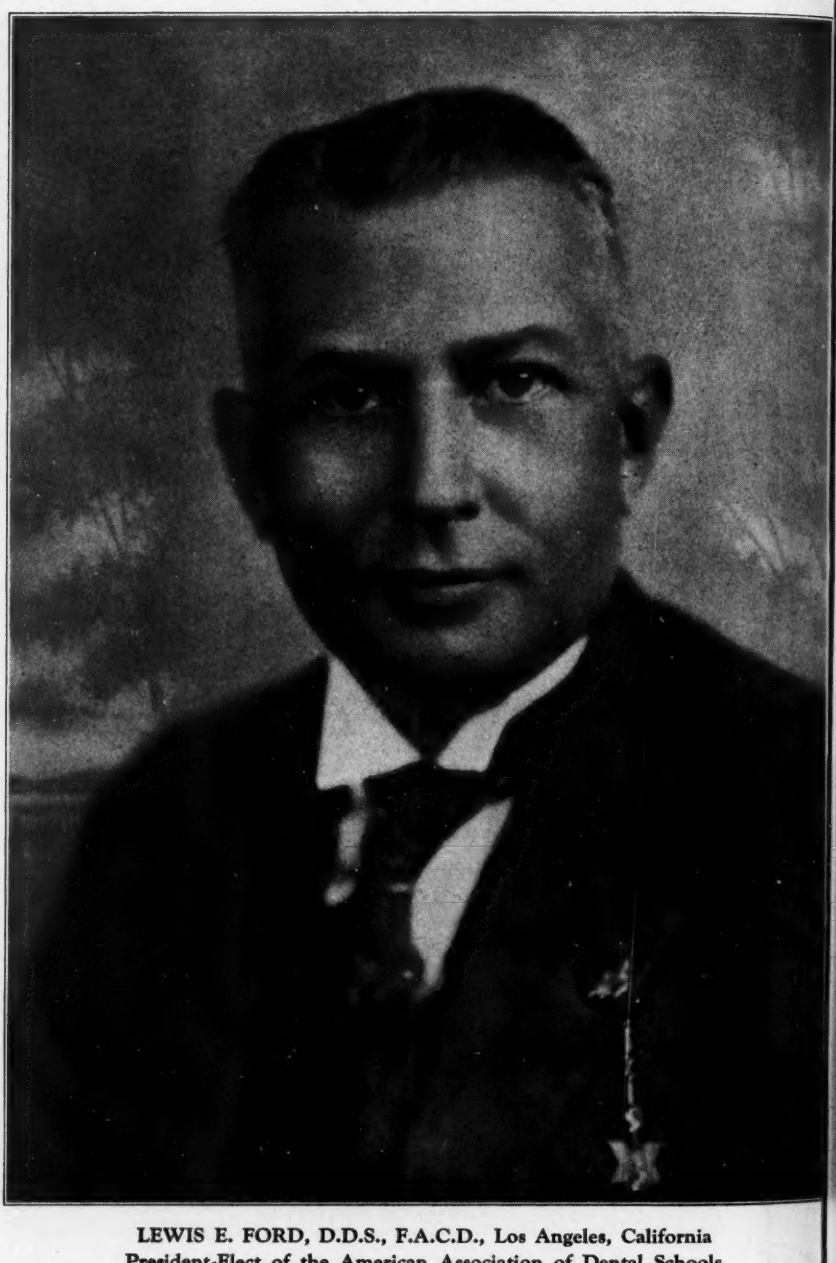

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Original Communications

COORDINATION OF DENTAL AND MEDICAL SERVICES IN THE TREATMENT OF BATTLE CASUALTIES*

By VILRAY P. BLAIR, M.D., St. Louis, Missouri, and
E. P. DAMERON, D.D.S., Washington, D. C.

AN opportunity to open a discussion on the subject of the coordination of dental and medical services in the treatment of battle casualties is greatly appreciated because the late war so amply demonstrated its immense importance in the treatment of face and jaw injuries, and also because, in almost all the activities of the Medical Corps, the Dental Corps proved itself a willing, cheerful and resourceful helpmate; this besides and beyond the fulfilment of the prescribed duties of the Dental Corps. True success in a military organization presupposes special skill, personal force and self-elimination, whether it refers to the individual or to an organization.

From time immemorial, the commanders of armies and the chiefs of all fighting hoards have numbered among their followers, surgeons or medical men to care for the wounded or to bolster up the morale. In earlier times, and among the less enlightened, these were seers rather than physicians, and even in the Roman armies, after the teachings of Hippocrates had been recorded, the average skill of the army surgeon was so poor that he was rated little better than a servant. Down to our own Civil War, the status of the medical corps often depended much

*Read before the Section on Military Surgery at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

more on the skill, resources and devotion of the individual than on any official position that was accorded the corps. It may be that the functional failures of a politically controlled medical corps in the Spanish War, as contrasted with results produced by the properly constituted and authorized Japanese medical corps in their late struggle with Russia, did much to gain for the medical corps of all armies their present recognition, which, in turn, enabled them to make such a tremendous showing in the late war.

In all army medical history, which is written on the pages of forty centuries and here sketched in as many lines, one thing stands out clearly: As a class, the medical corps has been given as much recognition and authority as its utility seemed to warrant; but, in the machine-like organization of an army, the usefulness of even exceptional individual skill is greatly hampered or totally nullified by lack of authority. This vicious circle would seem to explain the tardy recognition that has come to the medical corps.

It is hoped that you will pardon this mode of approach to our subject, but the dental corps is so closely allied to the medical corps that its establishment, its authority, its success and its handicaps are all controlled by the same influences as were those of the sister corps. Established at a time when the science and art of dentistry had arrived at an advanced stage of utility if not of perfection, it had few of the difficulties of recognition that for centuries clung to the medical profession, which, during much of that period, relied more on the superstition and ignorance of its clientele than on any real knowledge of the healing art. Further, from its establishment, the dental corps was accorded an official recognition that was won by the medical corps only by centuries of struggle. The medical corps is analogous to the self-made individual who labors a lifetime to establish his position; the dental corps is the privileged child of formal education, but one who has justified its advantages, and, in the few years of its establishment, has demonstrated itself not only a fit confrère, but a useful and much appreciated helpmate.

At a time when everybody that was to be fed, clothed and transported had to be counted individually, there were few functions of the medical corps that were not at times assumed and executed by dentists, and usually with credit. They served as executives, as mess officers, on special assignments, as anesthetists, as radiologists, gave first aid treatment in advanced dressing stations, etc., and there are many dental, as well as medical officers, who can make the proud boast of having served as stretcher bearers under fire.

This evidence of adaptability is here cited as an introduction to the consideration of teamwork in the treatment of certain types of battle casualties because it is probably the real reason why a plan projected on pure theory should have proved so eminently successful in practice.

Among the many special problems that must be listed on the preparation program of the Surgeon-General of the Army in time of war is the care of in-

juries of the face and jaws. These were a particularly trying problem in the allied armies in the earlier part of the war. In July, 1917, a section of the division of surgery of the head was organized, partly to take over this duty. The motive of the preparation was the conviction that if proper treatment could be instituted earlier and continuously carried out, to a proportionate extent conservation would displace reconstruction. . To make this practicable requires (1) a sufficiently large personnel to be available at every advanced and at all intermediate and base hospitals; (2) a definite general plan of treatment which, instituted in the advanced hospitals, is to be carried out without radical change in each of the hospitals to which the wounded are subsequently evacuated, and (3), and not unimportant, suitable equipment.

In providing personnel, it is to be borne in mind that the proper treatment of maxillofacial injuries rests on the same surgical principles as that governing wounds in any other part of the body; but because the efficient splinting of a fractured jaw requires dental splints, or splints with dental attachment, and because few surgeons have familiarized themselves with the physiology and the special pathology of the oral structures, to do the work aptly requires, as a rule, the cooperation of a surgeon with a dental surgeon who has made a special study of the subject.

There are available in this country a large number of dental surgeons who have made jaw splinting a special study, and surgeons whose training fits them for this cooperation.

In the late war, the Surgeon-General, with the generous and whole-hearted cooperation of both the medical and the dental professions, and of certain teaching institutions, established special short courses to familiarize certain selected surgeons and dentists with the proposed plan of correlated work. The selection of teachers was not confined to the faculties of these particular schools. A large number of surgeons and dentists were sent to take the courses, not with the idea that they could be made specialists, but that the dentists and surgeons could be shown the plan of cooperation, while splint making, the more likely problems, and the anatomy of the parts were being reviewed. Not the least important of the things accomplished by these schools was the compilation of data as to the qualifications of officers for the work.

The atmosphere of war, in spite of intense concentration, is one of distraction. All plans of specialization are more or less idealistic, and it takes time to put any subordinate plan into operation, especially if it is far-reaching in its application. Each hospital organized in the Surgeon-General's office had attached to it a surgeon and a dental surgeon designated for this work; but, in the earlier part of the severe fighting, all specialization was overshadowed by more vital problems. It is no secret that, owing to the lack of transportation, we were short of surgeons and dental surgeons in the American Expeditionary Forces, and that at Chateau Thierry most of the surgical consultants were ordered to form general operating teams, who worked in twelve-hour

shifts at the table in any hospital where they could find space; while the dental surgeons were often giving anesthetics, carrying the stretchers or giving first aid treatment. I have seen a hospital with an operating room capacity of 360 cases per twenty-four hours, at 2 o'clock in the afternoon, in all the confusion of raising the tents, which, before seven the next morning, had received 750 severely wounded, with the stream unabated; and I know of instances of even greater congestion. At one rail head, two consultants formed a team and carried stretchers for nearly a day.

The foregoing instances are mentioned to illustrate just one of the reasons why it takes time to establish these special services on a functioning basis.

After Aug. 20, 1918, there was a breathing spell, during which this service really got on its feet, and from the Battle of the Argonne, September 25, it was "on the job," and delivering service at all stations.

Efficient early treatment is the chief aim of all plans to care for battle casualties. In general, early treatment was a well established idea, at the time we entered the war. The Allies had pushed their advanced hospitals up within the firing zone because they had learned that whether their hospitalization resulted in an 80 per cent death rate or 80 per cent of the wounded returned to duty depended mainly on how early efficient treatment was instituted. Before we arrived, they had their plans for early treatment developed to a perfection which we never attained except in the maxillofacial injuries. In this particular branch, they were handicapped for want of a central organization and an efficient dental personnel sufficiently large to be distributed throughout all hospitals. The work done at their various maxillofacial centers was of the best order, but the cases reached these centers after the ideal time for the institution of treatment had passed, and progress was further retarded by lack of a uniform plan.

In this review of the work, it is impossible even to mention technic, but there is one thing that observation has strongly emphasized, and that is that delayed recovery and restoration are on the whole much more closely associated with delayed treatment and infection than with primary loss of tissue, and also that early treatment will prevent or control infection. An illustrative case is one of a man whose jaws were splintered, with wide tearing of the soft tissues, and there was neither proper fixation nor drainage at the time of injury, nor proper care at subsequent evacuations. There was resultant extensive necrosis, loss of teeth, nonunion and loss of bone substance, ten months later, when he entered a reconstruction hospital. After a long series of operations and splintings, a favorable result was obtained, but early correct repair and balance of defects would probably have accomplished a more satisfactory result, with only a small part of the actual work that was required. It was brought out more strongly than ever before that infection is the chief factor in delayed union or re-formation of the jaw bones, not necessarily accompanied by a free flow of

pus or extensive induration, but a quiet process, often difficult to detect, usually kept up by want of proper drainage and the presence of a foreign body, most likely an exposed tooth root or a piece of denuded bone. No matter how often the observation is repeated, it is interesting to note with what rapidity bony consolidation frequently follows the removal of a tooth or bone spicule from or near a fracture line that was apparently perfectly clean, but in which union had been delayed for months.

The last case of jaw injury in which I saw an operation performed in the American Expeditionary Forces was a fair illustration of the working of our plan for conservation. In the operating tent of a mobile hospital, I watched a young surgeon whom I did not know and one of our dental surgeons assemble, splint and repair a mandible that was shattered from angle to angle, with the lip, chin, and floor of the mouth torn open to the hyoid. When they had completed their work, the bony fragments were in their proper position and the soft parts repaired, all with proper drainage. There was left only a slight defect in the lower lip. Had this treatment been delayed thirty-six hours, the patient would have represented one of those horrible cases of total loss of the chin and body of the mandible which have been so frequently depicted. I never saw the patient again, that is, to recognize him, but, with the subsequent treatment we were prepared to give, it is probable that the soft tissues healed primarily, with bony consolidation within three to six months.

There are two other cases coming to my earliest observation, between which I have frequently made mental comparison. Before cooperation had been made practicable, April 25, 1918, one of the best operators in the American Expeditionary Forces had treated a case, with bad laceration and comminution, by ordinary surgical methods, with wiring of the fragments. The patient was evacuated and subsequently treated as though his were a general surgical case. Within a short period there entered the service of the same surgeon a similar case, which was treated by him and the dental surgeon jointly. I reencountered the second patient a month later at a base hospital. The soft tissues had healed with linear scars, jaw fragments were firmly splinted and in good position, and there was no pus. Six months later, I again met the first patient. He was in a profoundly septic condition, with fragments of dead bone protruding from the cheek wounds, and there was great deformity. He still requires a bone graft on each side of the body of the lower jaw and has no lower teeth by which to fix the fragments.

We were not able to carry out early continuous treatment even in the majority of cases, but the contrast between those cases in which it was done and those in which it was not was very great. By proper early treatment, I mean, first, the care of the vital forces of the injured man. The simple procedure of placing a patient who has an oral or pharyngeal wound in a sitting position, or, if he must lie, turning him on his face, will bring to the hospital many who would die on the way if allowed to remain in the supine position. A half inch rubber tube passed through the mouth into the oral pharynx will give a perfectly free airway in nearly all cases.

The factor which delays and complicates repair is sepsis, and, added to this, displacement of tissue, first by gravity and muscular pull, and later by infiltration and scar contraction. In but few cases is the amount of tissue originally destroyed the dominant factor. The early restoration of the remaining tissues to approximately their normal positions, when done with due regard to surgical principles, not only combats primary and secondary displacements, but also is the greatest preventive of sepsis.

The most congenial dressing for raw tissue is raw tissue, provided the circulation is good and drainage is established. It is difficult to imagine all periosteum and osteogenic cells being destroyed in a section of bone unless the covering of soft tissue is also destroyed; therefore, early splinting of the remaining fragments in their proper position with provision against sepsis by proper drainage will give earlier and more nearly perfect restoration than when the tissues are allowed to collapse and sepsis is uncontrolled. The tissues of the face will heal better than almost any other part of the body and are almost immune to the ordinary infections, while gas gangrene of the face, except in the orbit, is almost unknown. For these reasons, débridement should not be practiced on the face except for the removal of already devitalized tissue. It is too much to expect even the facial tissue to heal over a mass of comminuted infected bone without providing drainage, and some missiles will cause a devitalization of tissue that precludes restoration of circulation, but a certain amount of primary repair can be done in almost all face injuries even if it is only to follow Tuffier's advice as to suturing the mucosa to the skin to protect the raw surfaces. There are many men in the dental profession qualified to carry out these procedures.

We had no precise figures as to the total number of these cases, but from statistics for the Union forces in the Civil War; the Prussian Forces for the War of 1870-1871, and the British Forces for the World War up to Christmas, 1917, as a basis for calculation, they should average at least 1 per cent of all wounds, which, according to the last report of the wounded, May 31, 1919, would give a total of more than 2,371 cases of maxillofacial injuries treated at our hospitals.

About 600 of these cases were evacuated to this country, and the majority of patients had not been injured in the latter part of the war but before our cooperation plan began to function.

The majority of cases that require bone grafting do so not from the primary loss of all bone-forming tissue, but because of one or several of the following reasons: The bone-forming structures have been destroyed by infection; or there has been a want of proper early splinting, which, in itself, predisposes to infection. It is usually a combination of both these factors that is responsible for total loss of the segment, which is more liable to occur if bone fragments are removed at the time of injury. Instances in which all of the bone-forming tissues are destroyed by the original injury were the exception. Altogether, about seventy-five cases required grafting, or had been grafted, for bone loss in the lower jaw. Most of these were pedicle grafts, which require less time for union and are more certain in result than the free bone graft. It was the policy through-

out to restore the normal occlusions rather than to bridge defects by shortening the body of the jaw.

If I had the planning for the care of these injuries in another war, I would change the general plan projected in the office of the Surgeon-General in but one particular: I should have each surgeon and each dental surgeon who was entrusted with this work carry his emergency equipment with him as his personal baggage, with the understanding that his final assignment to this work would depend on his ability to keep this equipment available.

Transportation is the greatest problem in war, and everyone participating who has any grasp of the situation is primarily concerned in getting his essential paraphernalia to its seat of operation.

We learned to our bitter sorrow that having the most complete equipment which the nation and the government cooperating could provide buried in some base was no help to those who were caring for the wounded. Those concerned with the greater problems regarded, first, men; next, munitions; then, food; all other considerations being secondary. After two years of close observation of the conditions, circumstances and temperament that go to make up an American Army, I cannot conceive of an organization so perfected in detail that the ultimate distribution of special equipment of any kind can be assured when entire dependence is placed on the general plan of transportation. A few pounds of essentials stowed in his personal baggage would have been worth infinitely more to the dentist or the general surgeon than the several hundred pounds allotted that, in time, would have become available.

During the St. Mihiel drive, a dental surgeon of the mobile hospital telephoned the local consultant of the advanced area asking what he could use to take care of the jaw injuries that were accumulating. The consultant replied, "Use your wits," and slammed down the telephone. He had been asked this question once too often. To the credit of our dental surgeons, they used their wits, and by piecing out our own supplies with what the chief dental surgeon could obtain from the French; by beating 2 franc pieces into splints, by robbing the shell-cut telephone wires, and by cutting meat tins into splints, from the beginning of the Argonne campaign there were few patients who reached the base hospitals unsplinted.

The plan of having a director for this work who is in close touch with the chiefs of the surgical and dental divisions is essential to the proper conduct of the work. In no other way can the continuity of the treatment be maintained, and, for the same reason, area consultants who are in touch with the general plan of treatment and of evacuation are equally necessary.

At advanced hospitals, segregation or selection of cases is rarely possible. Rapid evacuation is the prime military necessity, and nothing can be allowed to interfere with it; therefore, these wounds can receive early treatment of a special character only by having those equipped to give such treatment available at every advanced hospital. In order to be able to meet emergencies, the supervising dental surgeon of the area should have at his disposal men who can be placed wherever the exigencies demand. The organization of an advanced hospital did not make it

practicable to assign, by a general order, special surgeons to this work in these advanced hospitals, but the dental surgeon on duty could go from table to table to work with any surgeon to whom a maxillofacial case fell. In most of the advanced hospitals that had in the personnel a dental surgeon who was capable of doing the work, sooner or later a local order was issued that assigned all such cases to his care, and at times the work he was called on to do was a tax almost beyond human endurance.

In the base and intermediate zone hospital centers, it is practicable to concentrate these cases in one hospital; which economizes both personnel and equipment, facilitates administration and greatly adds to the efficiency of the treatment. It is not practicable to send the patient in every special type of case to a special hospital as soon as he arrives at the center, and any hard and fast order will produce confusion and resentment; but, if a little time is given, all except multiple wounds can be concentrated and the surgeon in charge of each special service can serve as the consultant for the center in his branch, and with a little tact will have no difficulty in seeing all cases and transferring them to the limit of physical possibility.

If maxillofacial cases are to be evacuated home from over seas, great advantage will be derived from concentrating them on certain transports with a specially trained dental officer in charge. This will not only save interruption in treatment but also prevent unnecessary interference in the splinted cases.

Cases arriving home should be immediately sent to special centers already equipped with adequate personnel and material, and these centers should be so distributed that the wounded soldier will be within reasonable distance of his home.

In spite of some natural obstacles of war, through the kindly analysis given by General Gorgas, and the characteristic "go to it," which was the response of General Ireland to any worth-while proposition that seemed feasible, the planning of facial operations received a tremendous impulse in this country by the use of artists, sculptors and photographers, which the army furnished to cooperate with the surgeon and dental surgeon at all stations especially designed for this work.

The types of facial cases treated in the army have been presented elsewhere and are reviewed in this paper as a tribute to the consideration this work has received from the medical and dental department at large, and these cases represent a comparatively early state in the development of this work.

DISCUSSION

James E. Aiguier, Philadelphia, Pa.: Much of the success of either these operative units or the individual man was due to the understanding which Dr. Blair had with the dental surgeon. The schools of oral and plastic surgery throughout the country, which were organized to train these groups reviewed anatomy, physiology and surgery and many of the war problems which our allied nations had been confronted with during the past four years. The dental surgeons were qualified in anatomy after thus dissecting with and studying with the general surgeons. The dental surgeons were taught the control of hemorrhage, the technic for transfusion and the necessary operative technic in surgical procedures, so that they were well qualified to assist the surgeons in any emergencies, and in many instances, as the war proved, were qualified to carry on by themselves. Likewise, medical officers studied the problems of splints and restorations and other dental phases, which would present themselves from

time to time. In this way, they had a mutual understanding and could better assist each other in the many difficulties that arose. The dental surgeon proved his worth on numerous occasions. Dr. Blair has mentioned the hours of work necessitated by the various drives which resulted in many convoys returning with wounded soldiers. At our thousand-bed hospital during the height of the campaign, we would have as many as 4,000 patients, and, in many instances, the entire organization was called on to work most of the night to take care of the emergency cases which were continually streaming in. Dr. Blair brings out the fact that it was necessary to be equal to any emergency that arose. I recall how, on his return from the advanced area one day, he reported a case in which a soldier was wounded, the mandible being severed at the angle on either side and the tongue dropping back into the throat, with strangulation resulting. This patient could not have been transported without some method of stabilizing the jaw, and this was accomplished by a major in the field, with two tongue depressers, tied together in an X-formation. One end was attached to the anterior teeth of the lower jaw and the upper end was attached to the forehead by a bandage, the mandible being thus brought into proper occlusion and the tongue likewise brought forward. Suffocation was thus prevented, and the patient could be transported. The transportation of equipment was likewise a serious factor during the late war. In our base, the majority of the equipment with which we worked was brought over by the various officers as emergency equipment in their luggage. Owing to the other emergency equipment, it was almost impossible to deliver it from the coast to any towns which were of any distance in the interior, and, for that reason, we carried on during the entire stay in France without the original equipment, which was shipped and lost somewhere in transit. There were many other most interesting experiences, all proving that the dental surgeons who had the training were equal to any emergency.

GENERAL ANESTHESIA IN DENTAL SURGERY*

By WILLIAM GUY, F.R.C.S., L.D.S., Edinburgh, Scotland

OF late years, there have been great advances in the technic of the administration of anesthetics, largely based on a more complete knowledge on the part of the anesthetist regarding the physiology of respiration. The competent anesthetist of today, as Prof. Yandell Henderson puts it, "controls respiration to his purpose, or adapts his administration to the patient's respiration." The ideal anesthetic agent would paralyze sensation, volition and movement, without affecting any other of the vital processes. Such an agent is still to be sought. Every administration of a general anesthetic must involve the risk of some disturbance of mental and physical physiologic equilibrium, and even a certain risk, infinitesimal though it be in the case of the skilled anesthetist, to the life of the patient.

The main advance that has been made is due to the recognition of certain principles. The first is the principle of synergism, which establishes the fact that, if two or more drugs having similar therapeutic effects are used in combination, not only is a better effect produced, but the requisite dose of the combination is less than the dose of a single constituent. Hence, we find chloroform, ether, ethyl chlorid, ethylene and other narcotics being given in combination and sequence.

The second principle, recognition of which is responsible for the most important improvements, is, to put it as shortly as possible, that carbon dioxid is the normal stimulant of the respiratory center, and the controller of the respiration in volume and rhythm. The older physiologists knew that the activity of the respiratory center depended on the condition of the blood, being increased when the volume of venous blood was increased, decreased when the arterial blood was increased. To them, the important factor was the degree of oxygen deficiency, not the carbon dioxid content. Thanks to the work of Haldane, Yandell Henderson, Hill and others, we now know that the pulmonary air, containing about 5 per cent of carbon dioxid, produces in the arterial blood a pressure of carbon dioxid which is precisely that required to stimulate the respiratory center to the degree of activity consonant with respiration of normal volume and rhythm. The carbon dioxid content of the blood may, in various ways, for example by excessive breathing, be diminished—washed out of the blood and tissues. This diminution of carbon dioxid, or acapnia, deprives the center of its normal stimulus,

*Read before the Section on Exodontia, Anesthesia and Roentgenology at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

the breathing stops, and we have apnea, which is succeeded by anoxemia.

Acapnia, apnea, anoxemia, these are, or should be, the three bugbears of the anesthetist. He should sedulously avoid the appearance of any one of them, should reject every method of administration involving their production, and should confine himself to methods that enable him to control respiration, by insuring a sufficient supply of carbon dioxid to stimulate the center, and of oxygen to oxygenate the blood and the tissues.

I know not how it may be in America, but I count it a reproach to my own countrymen that, in spite of all that has been written, said and taught on this subject, old and discredited methods of anesthetization are still generally practiced. It is a lamentable thought that the methods that provide for the adequate supply of carbon dioxid and oxygen, and the consequent avoidance of acapnia and anoxemia, make headway but slowly. In some hospitals, chloroform, despite its dangers, or the chloroform-ether mixture is the routine anesthetic. In dentistry, the administration of nitrous oxid gas, given through valves (no rebreathing), is the anesthetic method almost universally employed. This method washes out of the lungs, with successive expirations, their content of nitrogen, oxygen and carbon dioxid, substituting in their place nitrous oxid. It is true that anesthesia is obtained, but with the most undesirable accompaniments. Here is the picture: acapnia, dyspnea, anoxemia, asphyxia, apnea, convulsions, asphyxial rise of blood pressure, distension of the right side of the heart. Death occurs by asphyxiation.

Nitrous oxid has been lauded as the safest of all anesthetics. Given through valves, it is the anesthetic which would, in the shortest time, poison the respiratory center, and kill by asphyxiation. Its so-called safety really lies in its extreme danger, the appearance of the patient at the point of asphyxiation being so significant of impending death that no one could refrain from snatching off the facepiece, and thus saving the patient's life by admitting air to the lungs. I repeat here what I said before: the man who today gives nitrous oxid through valves is going against the light.

Infinitely preferable, infinitely more scientific, infinitely more in accord with physiologic principles is the administration of nitrous oxid and oxygen by the rebreathing method. It is high time that it superseded the old asphyxial method, which I, here and now, discredit and condemn.

In anesthesia, there must be no anoxemia. Oxygen is the essential element in the biochemistry and biophysics of life. To cut down, or cut off, the supply of oxygen to a patient during induction or maintenance of anesthesia is an act of folly so extreme as to justify me in stigmatizing it as criminal negligence. If this Congress succeeds in driving the last nail in the coffin of the administration of nitrous oxid alone, as usually given, it will have done a great work.

I shall assume that there is a general consensus of intelligent and instructed opinion that nitrous oxid and oxygen, in mixtures, forms the safest anesthetic known. I shall further assume that, in dental surgery, it is the anesthetic of choice, either by itself, or along with adjuvant narcotic vapors.

Many forms of apparatus have been devised to secure certain desiderata, viz.:

the mixture of the gases in more or less definite proportions, the permission of rebreathing, the production of a certain degree of positive pressure, the provision of a rebreathing bag, to enlarge the stationary gaseous content of the lungs, plus the bag, and arrangements allowing the anesthetist to administer, along with the nitrous oxid and oxygen, other anesthetics, in the form of vapors, in any sequence or combination. The Teter, Clark and Heidbrink machines are familiar examples. There are many others, some of the employing the "sight feed" principle, as the Boyle, Marshall and Shipway types. I have, since 1911, employed the apparatus devised by Stuart Ross and myself. The essential parts are a rebreathing bag of 2 gallons capacity, having at its base a Y-tube, one limb admitting nitrous oxid, the other admitting oxygen. The oxygen is contained in a 1 gallon bag, which in turn is connected to an oxygen cylinder. A valved outlet pipe from the oxygen bag to the oxygen limb of the Y-tube has, interposed in its length, a bulb-syringe or bulb of 2 ounce capacity. By squeezing the bulb, known quantities of oxygen are injected into the rebreathing bag. To a tube on the bag mount of the breathing bag is attached, by rubber tubing, a small vial, which holds a measured quantity of the adjuvant narcotic, to be volatilized by heat during the induction.

In practice, this apparatus, the main merit of which is its simplicity, has proved effective and safe in a vast number of administrations to all classes of patients. The adjuvant vapor generally employed is that of ethyl chlorid, but the dose put into the vial must be strictly limited, if danger is to be avoided. From 1 to 2 c.c. may be used for children, never more than 3 c.c. for an adult. If many teeth are to be removed, from 3 to 5 c.c. of ether may be added to the ethyl chlorid to secure a longer period of anesthesia.

For nearly all dental operations, these methods, utilized to produce a single dose anesthesia, suffice. For the exceptional case, demanding continuous administration for a long operation, the nitrous oxid, oxygen and ether combination is indicated.

Yandell Henderson advises that the anesthetist add to his armamentarium a cylinder of a mixture of oxygen and carbon dioxid, to the end that he may exercise full control of the patient's respiration; which he accomplishes by adding this mixture to the content of the rebreathing bag, so as to produce the required degree of stimulation of the respiratory center. His advice should be followed when the administration is continuous. In the case of the "single dose" anesthesia, wherein induction occupies from sixty to 120 seconds, and when, with removal of the facepiece, elimination of the narcotics at once begins, I do not regard the provision of a cylinder of the mixed gases, oxygen and carbon dioxid, as imperative, though it may be prudent to have one handy. Let me now try to indicate what happens to the respired gases in a "single dose" anesthesia produced by the nitrous oxid mixture, either alone, or reinforced by ethyl chlorid or other narcotic vapor. The rebreathing bag is filled with nitrous oxid. The facepiece is firmly applied. The three-way tap is at "air." At the end of an expiration, the tap is turned to "no valves." Rebreathing begins.

At this point, the 2 gallon rebreathing bag holds about 9 liters. The lungs

contain probably about 3 liters, taking the vital capacity at 3.5 liters and the tidal air just expired at 0.5 liter. One-fifth of the air in the lungs is oxygen, so the lungs contain 0.6 liter of oxygen. The total capacity of the lungs plus that of the bag is 12 liters. We start rebreathing with 600 c.c. of oxygen in the lungs. This oxygen is sufficient to prevent acapnia and anoxemia for four or five respirations, and it will be quite safe to allow these four or five respirations before adding oxygen to the gas in the bag. In other words, the production of carbon dioxid will, for that short period of time, supply the demand. It then becomes necessary to supply successive additions of oxygen to the mixture in the lungs and the bag. This we do by squeezing the bulb twice at intervals. Every time we do this, about 120 c.c. of oxygen enters the bag. Squeezing twice at intervals of ten seconds, in 90 seconds we shall have introduced about 1,080 c.c. of oxygen, and the mixture in the bag and the lungs will contain about 10 per cent of oxygen, a proportion sufficient to maintain oxygenation and carbon dioxid production at a normal level.

These figures are, of course, only approximate. They would vary with lung capacity, rate of respiration and many other factors. In practice, it will be found that two compressions of the bulb every 10 seconds will keep the color of the face and the depth of respiration quite constant.

Ether ethylene, acetylene or other narcotics may be, and are, used in combination with nitrous oxid and oxygen, or with oxygen. With oxygen, they form explosive mixtures, and the danger thus introduced precludes their use in the presence of unprotected lights or other possible means of ignition.

Among many things that I am in the habit of insisting on, there are: 1. The patient's neck must never be stretched, nor the chin tilted up. 2. The mouth prop should be placed centrally. 3. The administrator should never tell the patient to take long or deep breaths. Forced breathing always brings about apnea. It is better to tell him to "blow it away." Voluntary expiration is succeeded by automatic involuntary inspiration.

SUMMARY AND CONCLUSIONS

Nitrous oxid by itself is an asphyxiant as well as an anesthetic agent and should not be used, save in mixture with oxygen. A satisfactory "single dose" anesthesia may safely be obtained by the rebreathing method, for operations lasting from thirty to sixty seconds, with nitrous oxid and oxygen, alone, or fortified by the vapor of from 1 to 2 c.c. of ethyl chlorid. For longer operations the amount of ethyl chlorid may be increased to 3 c.c., but this is to be regarded as the maximum permissible dose of the drug. For operations lasting for from ninety to 150 seconds, 3 c.c. of ethyl chlorid and from 3 to 5 c.c. of ether should be vaporized into the nitrous oxid and oxygen mixture. For prolonged operations, nitrous oxid, oxygen, and ether, or ether and oxygen are best.

ETIOLOGY AND SPECIFIC DIAGNOSIS OF ACTINOMYCOSIS*

By AVERY G. HOLMES, D.D.S., Washington, D. C.

ACTINOMYCOSIS, primarily a disease of cattle, is a comparatively rare disease in man, but a sufficient number of cases occur in human beings to make it of importance to the dental surgeon. The percentage of human cases occurring about the lower part of the face and neck has been variously estimated from 50 to 85 per cent of the total number and, because of its close association with the jaws, the responsibility for a diagnosis often rests with the dental surgeon. It is essential, therefore, that the dental surgeon be familiar with the methods used in the diagnosis of the disease.

The disease is produced as a result of an infection with *Actinomyces bovis*, more commonly called the ray fungus. The latter term has been applied to it because of the arrangement of its threads in a colony, in which they radiate from the center, and lending a raylike appearance. There are many other synonyms for the organism, the most commonly used of which are *Nocardia bovis* and *Streptothrix actinomyces*. This organism is of a slightly higher order than the schizomyces or true bacteria and belongs to the group Actinomycetaceae. It was first discovered, in the so-called lumpy jaw of cattle, by Bollinger in 1876, and was first demonstrated in disease of man by Israel in 1878.

The disease occurs most often in the male, the organism gaining entrance to the tissues through a break in the mucous membrane of the mouth or through a broken-down carious tooth. The chewing of infected straw or cereal grains, it has been generally supposed, is the principal mode of entry into the mouth. There is a tendency for the infection about the jaw and neck to metastasize, producing secondary lesions in the lungs or liver. Cases of primary infection of the lungs from the respiratory tract and of the gastrointestinal tract involving the liver have also been reported. Recently, C. F. J. Baron[1] reported a case of actinomycosis of the appendix in which no other tissues or organs were affected.

The disease belongs to the chronic granulomas and is characterized by a slowly developing swelling and marked induration of the surrounding tissues, usually painless, which may become markedly swollen, brawny and indurated. In the later stages, multiple nodules are formed which break down, forming sinuses, and from these a thick yellow pus is discharged. In the early stages of the disease, constitutional symptoms are not very evident. In some cases, there may be a persistent low fever and, in advanced cases, serious

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1. Baron, C. F. J.: Brit. M. J., 1:238 (Feb. 6) 1926.

constitutional symptoms may be manifest. The lymphatic glands of the neck become hard and swollen, and this enlargement of the glands is sometimes the first definite symptom. The condition so closely assimilates a number of others, such as gumma, tuberculosis, obstruction of Wharton's duct and sarcoma, that only the demonstration of the specific fungus in the lesion justifies a diagnosis.

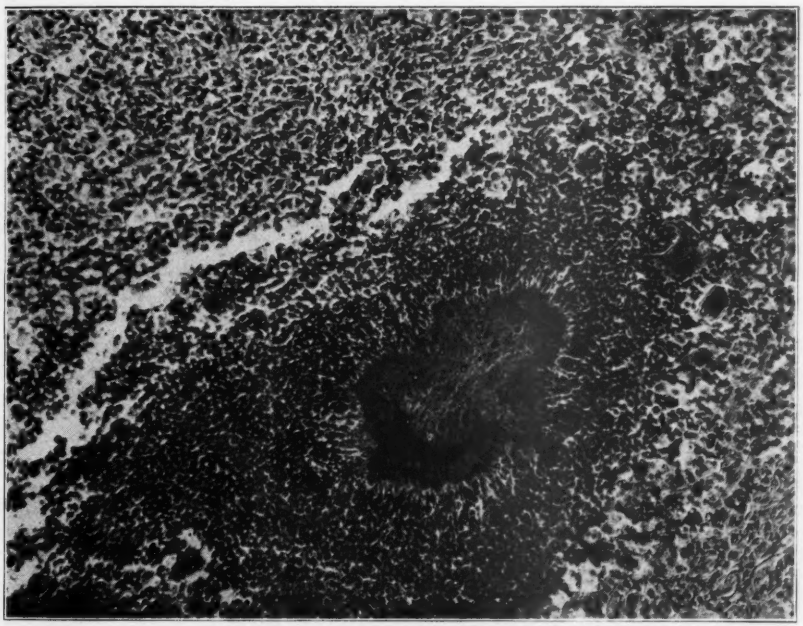

Fig. 1.—Section of tissue from human liver stained with hematoxylin and eosin; low magnification showing the actinomyces granule in the tissue.

DIAGNOSIS

The pus discharged, which is yellow and of a thick, creamy consistency, contains the characteristic opaque, yellow sulphur granules, which vary in size from about 0.5 to 2.5 mm. in diameter. These granules are characteristic of the disease and usually appear floating free in the pus, and if pus has not formed, they lie imbedded in the granulation tissue. Thomas and Van Dusen[2] recently reported a case in which the typical granules did not appear in the discharge. Microscopically, these bodies are made up of masses of filaments which, at the periphery, are radially arranged and show clublike terminations (Fig. 1). These bulbous, clublike ends are the result of the protective reaction of the fungus to the body tissues and are more commonly seen

2. Thomas, A. E., and Van Dusen, A. K.: Actinomycosis of the Mouth and Neck, J.A.D.A., 12:1320 (Nov.) 1925.

in animal lesions than in man. A section of infected tissue, which we have made from a human liver (Figs. 2 and 3), and stained with a bacterial stain,

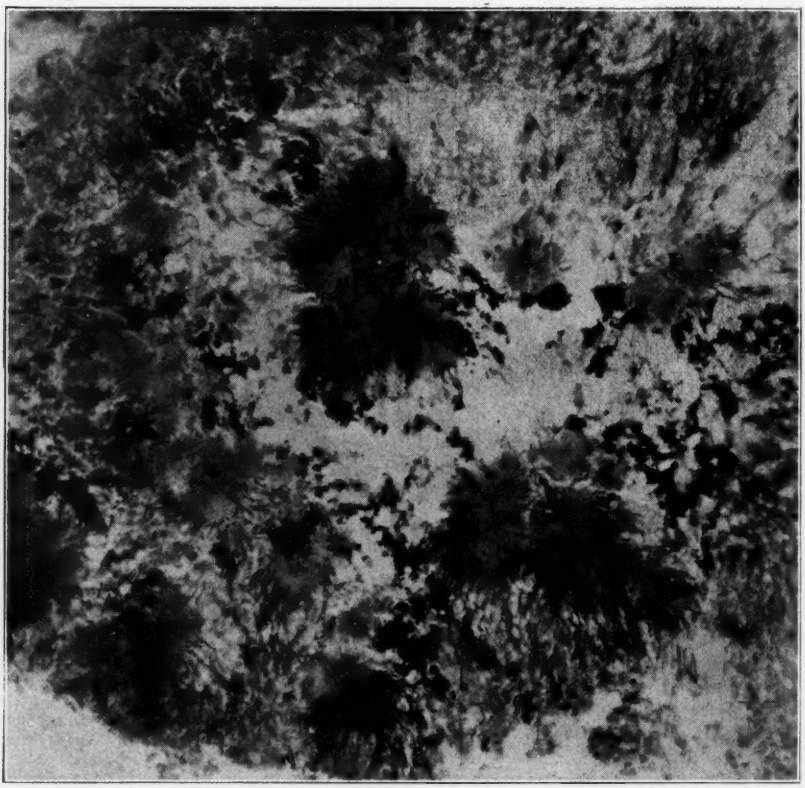

Fig. 2.—Section of liver from human case of actinomycosis stained with McCallum's stain to show the fungus in the colony.

shows the branching mycelium penetrating the tissues in all directions.

The fungus itself has been variously described as an anaerobe[3] and as an aerobe,[4] and several varieties of the organism, all capable of producing the disease, have been described. Gasperini described three types and called them *Nocardia bovis-sulphurea*, *Nocardia bovis-sulphurea-alba* and *Nocardia bovis-lutea-rosea*. It is best demonstrated in cases of actinomycosis by placing a small amount of the pus,

3. Goadby, Kenneth: Diseases of the Gums and Oral Mucous Membrane, 1923, p. 243.

4. Castellani and Chalmers: Manual of Tropical Medicine, 1919, p. 2130.

containing one or more of the granules, between two clean glass slides, crushing the granules by grinding the two slides together and staining by Gram's method. The fungus can often be demonstrated in a fresh unstained preparation by adding some material from a lesion to a few drops of 10 per cent potassium hydroxid on a slide and, after allowing the preparation to stand for a few minutes, crushing and covering it with a cover slip.

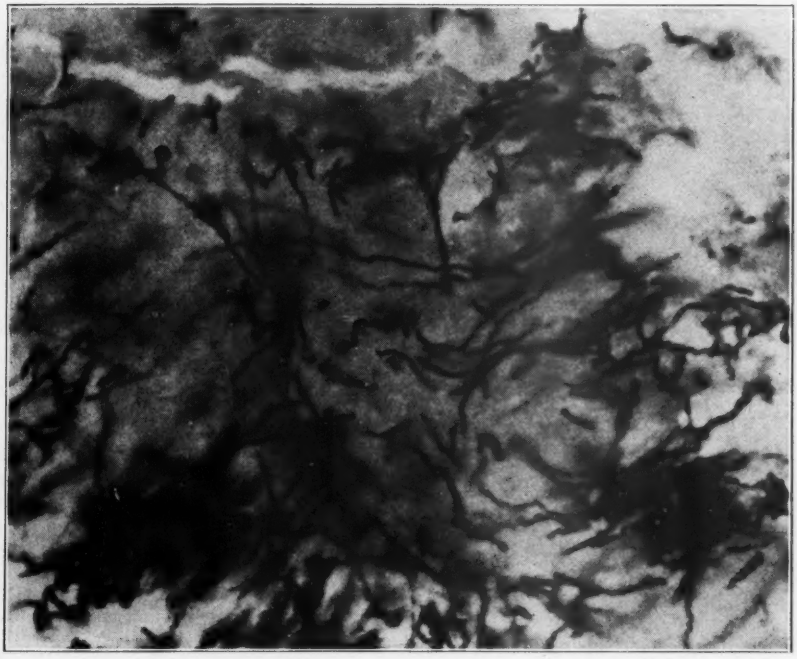

Fig. 3.—A high magnification of a small field from Figure 2, which shows the typical branching of the fungus in the tissues.

The organism I have studied was obtained from a typical case of actinomycosis of the lower jaw and neck admitted to the Walter Reed General Hospital and has been carried on laboratory mediums for several months. Aerobically, the fungus grew readily on agar slants, but more luxuriantly on agar containing 1 per cent of maltose. Colonies, after four days, were dry, raised, chalky and yellowish-white. The fungus grew on gelatin, producing small yellowish-white colonies and slight liquefaction of the medium after four days, but the growth was not abundant. On Loeffler's coagulated serum medium, there was a sparse colorless growth and no liquefaction. On potato, it formed raised chalky masses after two to three days, white at first but taking on a brown tint later. Litmus milk was unchanged. It grew

well in broth, giving rise to grayish-white cohering masses, from 3 to 4 mm. in diameter, which sank to the bottom of the medium. All cultures were incubated at 37.5 C.

Cultures also were incubated at 37.5 C. for five days under strict anaerobic conditions in a Brown anaerobic jar[5] from which the oxygen was removed by the oxidation of hydrogen method of McIntosh and Fildes.[6] After five days, there was a growth on agar and maltose agar slants similar to that on the same mediums incubated aerobically, except that the colonies were fewer and smaller. On Loeffler's coagulated serum, a few colorless colonies appeared. In broth, the growth was similar to that in broth cultures incubated under aerobic conditions except that the colonies were smaller and the growth was less abundant. Colonies were coherent and settled to the bottom of the medium. Litmus milk was unchanged, and there was no growth on potato.

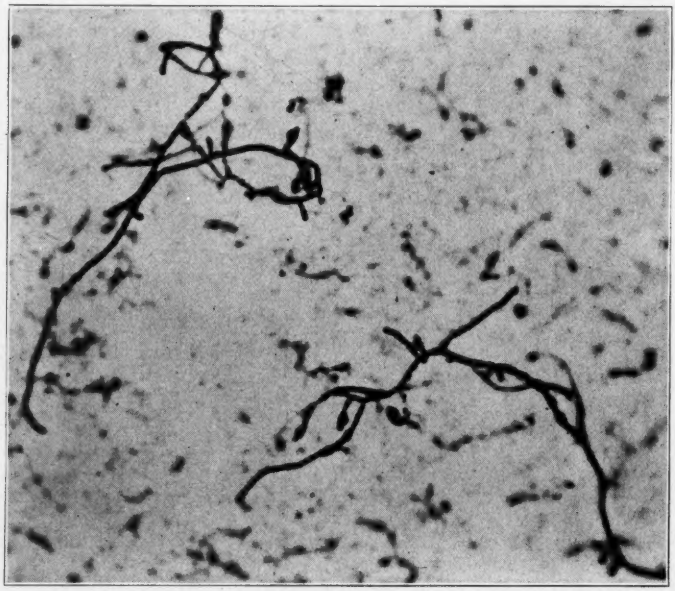

Fig. 4.—A smear from a 48-hour culture in broth of the organism studied; stained by Gram's method.

The organism stains with methylene blue, but better by Gram's method. It is gram-positive but not acid-fast. Smears were made from a 48 hour culture in broth by fishing a colony from the bottom of the culture, crushing between two slides and staining with Gram's stain (Fig. 4), and from a 60

5. Brown, J. H.: An Improved Anaerobe Jar, J. Exper. Med., 33:677 (June) 1921.

6. McIntosh and Fildes: Lancet, 190:768, 1916.

day culture on plain agar by adding a small amount of material scraped from the slant to a drop of salt solution on a slide and staining with Gram's (Fig. 5). The latter shows the mycelium broken up into many small coccus-like fragments. Conidia spores and these fragments, reinoculated in broth, grew out into the typical organism again. This stage probably represents the state of the fungus in which it exists for long periods in Nature on grass, cereal grains, etc. Glucose broth, p_H 7.2, inoculated with the organism, became more acid and gave a p_H value of 6.4 after four days in aerobic and anaerobic cultures.

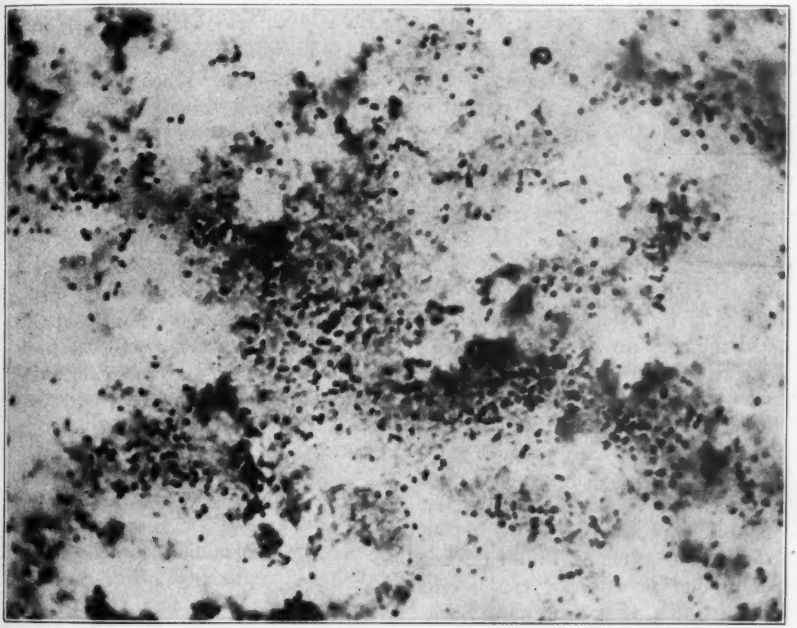

Fig. 5.—A smear from a 60-day culture on agar of the organism shown in Figure 4, and stained with Gram's stain. The mycelium of the fungus is here shown broken up into conidia spores.

SUMMARY

1. A thorough understanding by the dental surgeon of methods used in the specific diagnosis of actinomycosis is of considerable importance.

2. In typical clinical cases, when the typical granules and fungus can not be demonstrated in the discharge from the lesion, an effort should be made to obtain a small amount of tissue for sectioning and study. This method may show the fungus in the tissue when it cannot otherwise be found.

3. The organism in this case, after cultivation on artificial mediums, grows best aerobically, but is facultatively anaerobic.

STUDIES OF THE ENAMEL*

By R. W. LEIGH, A.B., D.D.S., Washington, D. C.

INTRODUCTION

ENAMEL is unique. It is the protective shield of the teeth. For them, it is an exoskeleton, and it may be compared in this respect to the shells of the Mollusca. The enamel is a limited and specialized part of the integument. Genetically, it is a highly differentiated ectodermic secretion. What the epidermis is to the body as a whole, the enamel is to the tooth. The enamel is both analogous and homologous to the epidermis. As the superficial layers of the epidermis are dead and do not react to infection or trauma, so the enamel is an inert, nonreacting tissue. As the epidermis possesses various histologic atria permitting the passage of bacteria to the dermis, so the enamel presents infection atria in the form of deep structural faults. Because of the conventional comparison of dental tissues as a whole with bone, both subnormal structure and the ubiquitous morbid process known as caries of the enamel have been confused with pathologic processes of bone; but there is no strict analogy between hypoplastic or carious enamel and infectious or metabolic disturbances of bone. Histogenetically, histologically, physiologically and pathologically, enamel bears a greater similarity to stratified epithelium than to bone. Since the health of the dental and paradental tissues, not to mention possible metastatic processes, depends on the integrity of the enamel cap, the logical place for prophylaxis is on its surface. It would seem that the focus of scientific attention has been unduly diverted to morbid periapical tissue. The motive of the following studies has been to secure additional data on the peripheral detail and on tissue conditions predisposing to the localization of dental caries, together with data on the nature of the initial lesion.

THE ENAMEL CUTICLE

In the crypt, before eruption through the gums, the enamel organ undergoes a transformation somewhat resembling keratinization. The enamel is closely covered by this transformed remnant of its genetic organ, and this cuticle remains intimately connected with and adherent to the coronary surface long after eruption. The cuticle is most closely adapted to all surface irregularities and is invaginated in every pit and fissure. Even in fissures closely approximating the amelodentinal junction, a double layer of the cuticle, forming a culdesac, may be found. The sides of the pouch may be in apposition in whole or in part. Though it may be in these places entrapped between the approximating lobes of enamel, which

*From the Laboratory of Pathology, Army Dental School.

*Read before the Section on Bacteriology, Pathology and Diagnosis, Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

have been produced by the different centers of amelification, the cuticle is morphologically always external to the enamel itself. As the different enamel lobes approximate each other in development, in many instances it would seem that the outer or occlusal portion of the fissure has become so constricted as possibly to have interfered with the function of the ameloblasts in the deeper part of the fissure, thereby preventing enamel from being secreted from the bottom up; and thus the separate lobes remained unfused. It appears probable that the genetic organ, in these places, got in its own way, permanent deep pits and fissures resulting. The enamel cuticle not only exists on the crowns of all newly erupted teeth but also may remain throughout life on surfaces unaffected by attrition, abrasion or chemical or bacterial agents.

As is well known, the enamel cuticle, or Nasmyth's membrane, consists, as a rule, of two layers: (*a*) a homogeneous translucent pellicle next to the free ends of the enamel rods, and (*b*) one or more layers of altered epithelial cells on the free surface. In some instances, through excessive change, no epithelial elements may be discernible, or the morphology of the cellular elements may vary considerably. Amitotic division of the nucleus is frequent, this being characteristic of cells whose function and life are drawing to a close. The inner surface of the pellicle, when stained, shows the imprint of the ends of the rods. By the use of Gram's stain before the cuticle is floated, bacteria *in situ* over a considerable area may be demonstrated. By careful technic, the cuticle may be preserved on the periphery of ground enamel sections. The whole cuticle is translucent and, therefore, macroscopically invisible. It is quite resistant to both acids and alkalis, and its presence assures protection to the chemically sensitive enamel against injury from acid. A stubborn resistance on the periphery of the tooth to a beginning decalcification has been attributed by Miller and others to a thin, dense cortical layer of enamel. The resistant factor has been the intact cuticle.

Sections show that, where there has been no break in the continuity of the cuticle over a considerable area, the enamel is unaffected by caries. The nonsusceptible area normally covered by the free gingivae is always covered with a continuous segment of the cuticle. The many physical, chemical and mechanical vicissitudes to which the teeth are subjected naturally break the continuity of the cuticle, and breaches afford entrance to the enamel surface. The free surface of the membrane also presents an excellent matrix for the localization of the oral flora. Attrition of the occlusal surfaces removes the cuticle from the larger part of this surface, but patches remain in the sulci. Many initial lesions of caries on both occlusal as well as approximal surfaces show the process to have begun under the very margin of segments remaining *in situ*. In pit and fissure cavities, this obtains: the beginning decalcification usually begins at the margin of the segment of cuticle at the outer or occlusal end of the fissure, rather than at the bottom where it is popularly supposed to begin; that is, the lesion begins at or near the bottom of the sulcus which is the outer part of the fissure, and penetrates the enamel alongside the invaginated cuticle. As is generally known,

the initial lesion on approximal surfaces is at the margin of the facet worn by the functional movement of the individual teeth in the arch. The *locus* of the initial lesion of approximal surfaces is the margin of the abraded cuticle just without the area of friction on the facet.

In beginning caries, the cuticle becomes greatly thickened, apparently by a heavy microbic collection on the exterior and a smaller invasion under it, and by imbibition of fluids by the cuticle itself. As calcium salts are washed away, the cuticle with adherent bacteria sinks into the depression. Bits of the disintegrated membrane may persist on the carious surface for some time. A critical examination of many of those most excellent illustrations published by J. Leon Williams in 1897 and 1898, and comparison with my sections, indicate that the substratum of the bacterial plaques described by him is the enamel cuticle. The localization of bacteria, however, is not dependent on the cuticle acting as a nidus. Lodgment is readily afforded not only by the grosser irregularities but particularly by the microscopic roughness produced by the escarpment of rows of enamel rods. There is evidence that the difference between cases of clinically dirty teeth that are not succumbing to caries and cases of fairly clean teeth that are succumbing to caries is partially determined by the presence or absence of the cuticle. I have recovered the cuticle from many noncarious but superficially badly stained teeth. However, the important factor of the bacterial exciting cause must not be disregarded. Solutions of iodin or dyes will frequently indicate the edge and extent of the remnant remaining in position on the teeth.

THE INITIAL CARIOUS LESION IN THE ENAMEL

Though the enamel, with its supporting dentin, is physically strong, because of its chemical composition it is very sensitive to acid reaction. The initial lesion of the enamel subjacent to the bacterial plaque consists of decalcification of the intercolumnar substance, producing innumerable interstices between the rods. The cross striae of the individual rods are next attacked. In some sections of carious enamel, there is visible an outer differentiated layer bounding each rod. Though this bounding line differs slightly from the body of the rod and the intercolumnar substance, it is completely calcified. This is not seen in normal enamel, and is, I believe, a new observation in carious enamel. The partially decalcified enamel contrasts sharply with normal enamel. The appearance of carious enamel simulates closely partially decalcified enamel produced by the application of acids in the laboratory. Carious enamel has considerable pigment in the interstices, which does not exist in partially decalcified enamel produced artificially.

Bacteria do not penetrate far into the interstices but adhere to the surfaces. The conditions in these spaces in this highly inorganic material apparently are altogether unfavorable for bacterial growth. Even where there has been sufficient destruction to permit penetration of pigments associated with the process, and in cases in which the tissue has been sufficiently affected to permit ingress of staining reagents, no bacteria are found far from the surface of the cavity. In hypoplastic enamel, in backward caries of enamel from the dentinal surface, and in fracture lines,

bacteria may be found. These features all present larger spaces than the minute intercolumnar interstices which are produced by decalcification in advance of bacterial ingress. The predominant type of the organisms stained in most intimate relation with the enamel appears to be a short bacillary form.

The entire thickness of the enamel, as well as a considerable depth of the dentin, may be partially decalcified without any appreciable break or cavitation in the periphery of the enamel. This porous form may hold for some time the natural contour of the tooth; but, through continued decalcification, aided by physical forces, the surface is broken down until that most highly susceptible area at the amelodentinal junction is reached, where the process rapidly and extensively spreads in a lateral direction, undermining what may have been previously sound enamel. Masses of bacteria are adherent to the surface of the cavity as it progressively deepens toward the dentin. Sections from teeth that have been subjected in bulk to staining reagents, such as silver nitrate or fuchsin, show penetration of the affected carious enamel in sharp contrast to the solid, unpenetrated normal tissue. Thus, an extensive and deep partial destruction of the hard parts may exist without the knowledge of either dentist or patient.

STRUCTURAL INTERSTICES PENETRABLE BY STAINS

If erupted, adult enamel, either normal or hypoplastic, contains an organic matrix, vulnerable atria for the penetration of caries-producing micro-organisms would be present. With a view of demonstrating possible strings of organic material, or tissue peculiarities determining localization of the caries process, teeth were subjected to stains *en masse*, then sectioned by grinding and mounted for microscopic examination. This method is of interest because, theoretically, the manner in which stains penetrate in bulk may indicate avenues through which nutrient fluids may pass.

The method employed is simple; and the results as affecting the penetration of staining solutions into various spaces in different parts of the enamel cap were as satisfactory and conclusive, I believe, as those of any other worker in this particular field. The best results have been obtained from the use of freshly extracted teeth, eliminating solution of formaldehyd from the technic entirely, passing the teeth through graduated solutions of alcohol, and then immersing them in one of the following stains: 2 per cent alcoholic solution of basic fuchsin, gentian violet or brilliant green; or a 10 per cent aqueous solution of chemically pure silver nitrate. The roots were resected to permit free access of the solutions into the pulp chamber. A varnish of celloidin was used on the exterior of the enamel in certain cases to prevent the tooth from being subjected to stains from both surfaces. After the teeth had been in the staining solutions for varying periods, some were bisected longitudinally, and others were cut in cross-section blocks, and then ground on Black's microlethofer, under either water or paraffin oil, to approximately 10 microns. Experience with this method indicates that it is unnecessary to resort to high-pressure injections of the solutions. Our greatest difficulty was encountered in preventing decoloration of the blocks during the grinding and demounting.

Strictly speaking, intact, normal enamel is unstainable, impermeable to, and unpenetrable by, staining solutions. However, enamel is not always a perfect tissue, true to type, but exhibits variability in density of structure. Various gross and microscopic spaces, leading either from the free surface or the amelodentinal junction, may exist. Incisors and cuspids are more compact than bicuspids and molars. In origin, the interstices have resulted: (*a*) from incomplete calcification of either the rods or the intercolumnar substance, hypoplasia; or (*b*) through exposure to a decalcifying environment. Staining solutions will readily penetrate into these interstices, and the stains be precipitated therein. But the penetration of stains into cavities, or incompletely calcified, or partially decalcified, areas, or the mere precipitation and smearing of metallic stains on intact enamel surfaces, is not true tissue staining any more than is the penetration of stains into checked glass or precipitation of reagents on its surface to be considered staining of the glass. A classification of the various spaces in human enamel into which stains penetrate will aid in an analysis of this problem.

The stains used penetrated from the free surface into the following tissue conditions: (*a*) macroscopic and microscopic hypoplastic defects, including pits, fissures or faults; (*b*) fracture lines, bruised areas, or any part of the enamel cap affected by physical trauma; (*c*) carious enamel, that is, partially decalcified areas ramified by many interstices between the rods as well as partial disintegration of the rods; (*d*) mottled enamel, or incompletely calcified enamel of any type; (*e*) areas that have been partially decalcified with fixing, staining or other laboratory reagents; in particular, solutions of formaldehyd and of crude silver nitrate. The enamel cuticle takes the stains deeply and will tend to inhibit penetration of the stain beneath it.

Stains diffuse readily through the dentinal tubuli and across the amelodentinal junction into the following structural elements and tissue conditions: (*a*) simple dentinal tubuli that extend across the border a short distance and usually terminate between the rods; (*b*) enamel spindles, probably better described as ampullae, or culsdesac, into which dentinal fibrillae pass, or which may really be terminal enlargements of the dentinal fibrillae in the enamel, and which appear constantly near the apices of dentin cusps and also near the cervical border, as observed in cross-sections; (*c*) irregular brushlike areas with short stems at the junction, which may be called tufts, but structurally are probably spiral arrangements of loosely cemented enamel rods; (*d*) areas of granular rods in which the formative elements, the globular calcospherites, have not been completely calcified; (*e*) frank hypoplastic areas or anomalous cavities, some of which may extend to the periphery of the enamel, sometimes in the form of channels loosely filled with amorphous calcific material; (*f*) fracture lines; (*g*) carious enamel. All of these conditions are exemplified in the sections exhibited. In the photomicrographs, the dark portions usually correspond to the stained portions in the microscopic sections. Cross-sections of enamel reveal much that has not been well understood. The self-evident and well-known nature of most of these conditions of the enamel into which stains will penetrate obviates further description. A short discussion of controversial elements follows.

Cross-sections of teeth subjected to stains *en masse* show penetration in well-defined narrow spaces leading from the free surface to the dentin. Even teeth chosen because of the macroscopic soundness of their enamel exhibit these clefts. C. F. Bödecker refers to these lines as enamel lamellae and considers them organic in nature. Many of these lines are nothing more or less than fracture lines in the enamel cap in its thinner portion, approaching the cervical border. Others are centers of areas of incomplete calcification of the intercolumnar substance, often in the center of a group of spirally arranged enamel rods. In either of these conditions, extraneous materials may enter from the free surface: substances from the oral environment while the teeth are *in situ;* celloidin during the embedding process, and stains. Silver nitrate will penetrate through these clefts to the dentin and diffuse laterally at the junction into mushroom-shaped areas. A foreign substance that has previously penetrated the clefts may remain as a residue after decalcification of the surrounding enamel.

The prolongation of dentinal fibrillae for short distances across the amelodentinal junction has been questioned. Cross-sections, in particular, of teeth subjected to stains frequently show one or both of the dichotomous branches well defined, passing the junction and ending blindly with a discrete, abrupt tapering. They appear to be between the rods, and they pass well beyond the indentations between the convexities of the dentinal surface of the enamel.

Surrounding the apices of dentin cusps, and also in the region of the cervical border, are many spindle-shaped, blind-ending culsdesac or ampullae. These bodies have been observed by many histologists, but their true nature has never been satisfactorily demonstrated. They are much longer, larger and more irregular than the simple dentinal fibrillae endings above referred to. They lie tangentially to the rods and often appear to contain a granular or beaded content, Römer's corpuscles. Apparently, dentinal fibrillae pass into them, as well-defined continuous lines from the tubuli, which have taken the stain evenly, pass into them. Fuchsin stains the ampullae evenly and deeply. Douglas Caush was the first investigator to demonstrate the ampullae clearly through the use of stains. John S. Marshall and others have since studied these bodies extensively through staining methods. With reference to their location, the statement of Otto Walkhoff that they "are totally lacking at the cervix of the tooth," is untenable in the light of cross-sections subjected to stains. Because of their very definite structure and constant occurrence in the locations indicated, the ampullae must be considered normal histologic entities within the enamel, and they are readily penetrated by stains from the dentin. It is probable that the ampullae are of vestigial significance, being homologous to the spaces in tubular enamel of lower organisms.

Another structure of the enamel that has been confused with the discrete ampullae above referred to are brush-like areas with a constricted stem at the amelodentinal junction. The word "tuft" has been applied to these areas because of their similarity in outline to a bunch of grass or brush. The stains penetrate into and diffuse within these areas. It would appear that they represent structurally a spiral arrangement of the enamel rods in which the intercolumnar cement substance is poorly

calcified and thus permits the ingress of stains from the dentin. These bodies, which have also been referred to as whorls, may, because of their constancy in multicuspidate teeth, be properly considered normal enamel formations. The intercolumnar spaces appear broader and more conspicuous in these areas than elsewhere. These brushlike areas, or tufts, are not at all identical with enamel spindles or ampullae, as is claimed by Beust. In many sections, the large tufts and the much shorter discrete ampullae are sharply differentiated. The ampulla is a small discrete element: the tuft is a large area in which the calcification of the intercolumnar substance is deficient. The ampullae are rarely as long as the usual tufts. Discrete ampullae may be observed within tufts. In any given area, the ampullae generally run parallel to each other, practically always tangentially to the rods, at acute angles to the tufts, and approximately at right angles to the amelodentinal junction. The tufts always run with the rods, and the latter in these locations are usually of irregular or spiral arrangement. In cross-sections, near the cervix, innumerable ampullae may often be observed, as well as long narrow tufts or spirally arranged dispersions of the rods. The tufts are apparently aggregations of rods in which the intercolumnar material is incompletely calcified. This condition may be the result of a lateral developmental spreading of the crown, which interferes with calcification.

Occasionally, there are areas of enamel in which not only is the intercolumnar substance poorly calcified but also the calcification of the rods themselves is not consolidated, and stains penetrate into and diffuse throughout the area. It would appear that the formative elements, calcospherites, have failed to coalesce.

Most of the foregoing conditions doubtless involve physical spaces or intercolumnar interstices of various sizes. These tissue conditions were brought about by incomplete calcification developmentally; or later, through environment, by partial decalcification of the enamel. Some of them, such as the ampullae, in the fresh or living condition possibly are filled with fluid, though this is problematic. From the observed penetration of stains into these areas and diffusion therein, the implication of an organic content of the enamel is unjustified. Since there are no cells in human enamel, requirements for and existence of metabolism in this nonregenerating, nonreacting ectodermic secretion are highly improbable. Histologic examination, aided markedly by the method herein described, has revealed no evidence that adult, erupted enamel undergoes further calcific consolidation: newly erupted teeth are no more penetrable to stains in bulk than are teeth that have been exposed to the oral environment for years. After eruption, there is no accrementition to the enamel either by consolidation or increased volume. The hypothesis proposed in the opening paragraph of this section, that an organic matrix furnishing atria for the ingress of microorganisms may be the determining factor in the localization of caries of the enamel, is unproved and improbable.

MORPHOLOGIC FEATURES DETERMINING LOCALIZATION OF DENTAL CARIES

Dental caries is strictly a localized process; its occurrence is usually bilaterally symmetrical. This symmetry

indicates internal as well as the external exciting factors in the process as far as the area attacked is concerned. Intrinsic characteristics of individual teeth help to determine the localization of the process. The incidence of caries in the individual teeth and their various surfaces differs widely. The mandibular anterior eight teeth and also the maxillary cuspids enjoy a high degree of freedom from caries; but these teeth are of simple structure, with no accompanying developmental faults. At the other extreme, the mandibular first molar is affected by far the most often. It has an intricate structure with accompanying developmental defects, and it presents a longer line of fissures than any other tooth. But the structural defects in this tooth, with the exception of the buccal line and pit, are practically all on the occlusal surface, and concomitantly, the localization of carious lesions on the occlusal surface is almost double the combined occurrences on all other surfaces. Although the factors of anatomic relationship with other teeth, tongue, cheeks and orifices of the salivary ducts, function and hygiene, must not be ignored, the accumulation of reliable data accentuates a strong correlation between the incidence of caries in the different teeth and their respective surfaces, and intricacy of structure of the teeth, with which is constantly associated structural faults.

At the bottom of pits and sulci are deep structural faults, in a large percentage of present-day cases in white people. Some of these faults lead into the subjacent dentin. These fissures are usually so minute that even the point of the finest explorer is too large to enter. They are partially occluded with a double layer of the enamel cuticle; and, at their orifices, bacterial colonization is insured protection under abraded edges of the cuticle. In addition, the sulci, from which the fissures lead, form natural retention centers for food débris, thus supplying the nutriment requirements for fixed bacterial proliferation. The sides of the fissures are frequently composed of hypoplastic, or other developmentally defective, enamel. Loosely constructed enamel succumbs to the process of decalcification more rapidly than well-formed enamel, greater surface areas being subjected to the decalcifying agent. In well-formed enamel, such as that on approximal surfaces, decalcification is slower, and very frequently a state of arrested caries is noted. No form of true prophylaxis has been developed against the carious destruction of enamel about these minute developmental faults.

The localization of the caries process on approximal surfaces is determined by the facet which is soon worn there by functional movement of the teeth. This wear disrupts the otherwise protective cuticle. Unprotected enamel cannot cope so successfully with a deleterious environment as enamel covered by the cuticle. The peak of occurrence of caries both in fissures and on smooth enamel surfaces is during early life.

At the cervices of many teeth, especially in persons beyond middle life, there is an area of denuded cementum or dentin, due to atrophy of the gingivae. In a considerable percentage of teeth, there is a congenital absence of enamel or cementum over a band at the cervix. Denuded areas at the tooth cervix have a high liability to caries. Dentinal tubuli, or the penetrating

canals in the cementum, are readily invaded by micro-organisms. Sometimes teeth that evidence no caries of the enamel succumb to caries of the dentin at the cervix. The peak of occurrence of caries in this location is in later life, and hence the condition has been referred to as senile decay. The cervico-proximal surface is the usual site of caries in primitive people.

SUMMARY

The enamel is a highly differentiated part of the integument. It is a completely calcified ectodermic secretion. On its integrity, the health of the dental and paradental tissues largely depends. Nasmyth's membrane, or the enamel cuticle, is the transformed remnant of its genetic organ. The cuticle holds tenaciously to the free surface of the enamel, and is invaginated in every pit and fissure. Its resistance to acids is marked, but attrition and other agencies remove it from large areas of the enamel surface. The cuticle may serve as a nidus for bacterial proliferation; and its abraded edges protect fixed colonization of the exciting cause of dental caries. By careful technic, the enamel cuticle may be demonstrated transversely on the periphery of ground enamel sections, or in large pieces by flotation.

In caries of the enamel, bacteria do not penetrate far into the interstices produced by their enzymic acids, but adhere to the surface for the most part. Bacteria may be found in the larger spaces and in fracture lines. The entire thickness of the enamel, as well as a considerable depth of the dentin, may be partially decalcified without any appreciable break in the periphery of the enamel. This skeltonized form will eventually succumb.

The enamel cap of teeth subjected to staining solutions before sectioning will show penetration of the reagents into gross and microscpic spaces. In origin, these spaces, or areas into which the stains may diffuse, are the results of either (*a*) developmental defects in the nature of hypoplasia, or (*b*) decalcification by a deleterious surface environment. Intact normal enamel is unstainable, but metallic salts may be precipitated on its surfaces. An organic content of the enamel, with the possible exception of short extensions of the dentinal fibrillae across the amelodentinal junction, has not been demonstrated by microscopic methods; and, because of the technical difficulties in analyzing enamel *per se*, chemical methods are inapplicable and unreliable in this instance. Considering its histogenesis, and other data, the presence of an organic matrix, or metabolism, in the enamel is highly improbable.

Accumulation of reliable data indicates a strong correlation between the incidence of caries in the different teeth and their respective surfaces, and intricacy of structure of the teeth, with which is constantly associated structural faults. The hypoplastic fault affords a nidus for caries-producing micro-organisms, and loosely constructed enamel succumbs more rapidly than compact enamel. Partly because of the minuteness of many developmental pits and fissures, no form of prophylaxis against caries in these susceptible locations has been developed. Silver nitrate has little if any prophylactic value in enamel, although it may be of considerable value in dentin. Pits and fissures are not fortified in the least against caries by tooth-polishing methods.

BIOLOGIC CHEMISTRY AND THE DENTAL CURRICULUM*

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DENTISTRY and medicine are closely related branches of the healing art. A diseased condition of the teeth and mouth may affect the general health. Likewise, certain diseases, such as scurvy and syphilis, may give rise to definite lesions of the mouth and teeth. Medicine and dentistry share many problems, both theoretical and practical; problems of diagnosis, of treatment and of education. Since many phases of both medicine and dentistry are essentially chemical in nature, it is necessary that the dentist, like the physician, have a working knowledge of biologic chemistry in general, and especially a knowledge of the chemistry of the human organism in health and in disease.

Biologic chemistry is essentially a quantitative subject, based, in part at least, on physical chemistry. The student of biologic chemistry should, if possible, be familiar with the principles of inorganic chemistry, qualitative analysis, quantitative analysis, physical chemistry and organic chemistry. It is essential that he have a knowledge of at least inorganic chemistry and organic chemistry.

Biologic chemistry is not merely a science by itself. It is also the basis of many of the medical sciences. In bacteriology, apart from morphology and motility, the indentification of species is dependent on their chemical reactivity toward certain dyes and certain substrates and immune serums. Immunology is based on certain chemical laws and reactions. The procedures of laboratory diagnosis are usually chemical in nature. Pathology, histology, pharmacology, toxicology, physiology and other branches of medicine have close relations with biochemistry.

Today, every medical college belonging to the Association of American Medical Colleges requires of its matriculates[1] the completion of sixty semester hours (two years) of collegiate work, including the following minimum credits in semester hours: general chemistry, eight, at least four of which are laboratory; organic chemistry, four; physics, eight, at least two of which are laboratory; biology, eight, at least four of which are laboratory; English literature and composition, six. Qualitative analysis may be included as part of general chemistry.

Experience has demonstrated that a

*From the Constantine Hering Research Laboratory of the Hahnemann Medical College.

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1. Proc. Ass'n Am. M. Colleges, 36:175-176, 1925.

high school graduate can be given not only these required courses in the sciences, but also additional courses in science during the two premedical years. Since the autumn of 1917, the faculty of science of the Hahnemann Medical College and Hospital of Philadelphia has offered a premedical course of two years. On satisfactory completion of this course and the first two years in medicine, and the presentation of an original thesis, the student receives the degree of bachelor of science. The subjects included in this premedical course are listed in the accompanying table.

PREMEDICAL COURSE

	Semester Hours	
	Lecture and Recitation	Laboratory
General chemistry	3	3
Qualitative analysis	3	3
Quantitative analysis	2	3
Organic chemistry	6	3
Physical chemistry	2	1
Physics	7	3
Zoology	8	8
Botany	4	0
English	10	0
Mathematics	4	0
Sociology	4	0
Modern foreign language	8	0

A course of the type just described gives a firm foundation for the study of medicine, and would be an admirable predental course, if the student is in a position to devote two years to that stage of his education.

At the present time, a candidate for admission to a dental college in Pennsylvania[2] must have completed one year of work in an approved college. This work must "include at least six semester hours of English; six semester hours of chemistry; six semester hours of biology or zoology; and twelve semester hours of elective work." A student may offer more than six semester hours in any of the required subjects. Some dental colleges have adopted additional requirements for admission. Thus, the Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, announces[3] that, beginning in September, 1927, all candidates for admission must have completed two years of instruction in an approved college of liberal arts and science, including not less than six semester hours each of English, biology or zoology, chemistry and physics. No mention is made of organic chemistry as a required predental subject.

The School of Dental and Oral Surgery of Columbia University[4] has, as a minimum entrance requirement, the completion of a collegiate course of at least seventy-two semester hours. This course must include "one year of physics, one year of biology, one year of inorganic chemistry based on college entrance chemistry, one-half year of qualitative analysis, one-half year of organic chemistry, two years of college English and one year of either French or German." The courses in physics, biology and chemistry must include laboratory work.

Frequently, persons who have spent one or more years in a dental college, and even doctors of dental surgery, desire to study medicine. They must satisfy the entrance requirements of the medical school, and are often embarrassed by a lack of organic chemistry,

2. Commonwealth of Pennsylvania, Department of Public Instruction, General Information, Bur. of Professional Education, December, 1924, p. 4. (Pamphlet.)

3. Univ. Pennsylvania Bull., 25: 17, No. 32, 1925.

4. Columbia Univ. Bull. of Information, Ser. 26, No. 27, p. 15, 1926.

physics or some other subject which must be acquired prior to matriculation in medicine. Therefore, it would be highly desirable that the entrance requirements of dental schools be made identical with those of the Association of American Medical Colleges.

Even if a student is restricted to a one-year predental course of collegiate grade, he may be given instruction in the rudiments of organic chemistry in that course. An intensive course in inorganic chemistry may be given in the first semester, and be followed by an intensive introductory course in organic chemistry in the second semester. When I was a student in the Central High School of Philadelphia, I profited greatly by a course of five semester hours in the chemistry of the inorganic elements, followed by a course of five semester hours in organic chemistry. These courses were required subjects. In addition, I was able to take, as elective subjects, courses in the chemistry of the metals (two semester hours) and qualitative analysis (two semester hours). Each of the four courses included lectures, recitations and laboratory work.

As an example of the instruction in biologic chemistry given to medical students, the courses in that subject, required of freshmen in the faculty of medicine of the Hahnemann Medical College and Hospital of Philadelphia, will be outlined. These courses are given by Dr. William A. Pearson and me. Physiologic chemistry is taught during the first semester, clinical chemistry during the second semester. These courses follow the text of Pearson and Hepburn.[5] Instruction is given by lectures and recitations, and by laboratory work.

The course in physiologic chemistry includes six lecture periods and twelve laboratory hours weekly for the semester. It begins with a concise summary of the methods and procedures of quantitative analysis for the benefit of students who have not previously had a course in that subject. This is followed by a short review of organic chemistry as an introduction to physiologic chemistry proper. By far the major portion of the semester is devoted to the study of carbohydrates, proteins, enzymes, the tissues and their chemical composition, and foods and metabolism.

The course in clinical chemistry includes four lecture periods and eight laboratory hours weekly for the semester. It is devoted to a study of saliva; gastric digestion; intestinal digestion, including the bile and the pancreatic juice; the feces; the blood and cerebrospinal fluid; the urine; milk, and the sanitary aspects of the chemistry of water.

In our experience, this course is readily followed by students whose premedical collegiate work has not included courses in analytic and physical chemistry. Of course, the rudiments of physical chemistry are discussed in modern courses in inorganic chemistry. Students who have enjoyed the benefit of collegiate courses in analytic chemistry make more rapid progress in biologic chemistry.

The courses in physiologic and clinical chemistry, outlined above, are followed by a course in toxicology, which is given by the department of chemistry and includes two lectures and six laboratory hours weekly during the second

5. Pearson, W. A., and Hepburn, J. S.: Philadelphia, Lea and Febiger, Physiological and Clinical Chemistry, 1925, pp. 1-306.

semester of the sophomore year in medicine.

The course in biologic chemistry (physiologic and clinical chemistry) as given to medical students must be broad in its scope and logically developed. In its development, stress may be placed incidentally on biochemical subjects of especial interest to the practitioner of medicine, e. g., methods for the quantitative measurement of the functional activity of the thyroid, stomach, pancreas, liver and kidney. The course for a dental student should be of a similar nature, with stress, incidentally, on the biochemical subjects concerning which the practitioner of dentistry must have a working knowledge. Through the medium of popular science literature, the general public has acquired an acquaintance with such subjects as the endocrines, the vitamins and bacteria, and, as a result, the patient expects his dentist to be an authority on such subjects as these in their dental relationships. Moreover, many biochemical facts have a direct bearing on dentistry itself. A few examples may be given.

The composition of the saliva has been studied to but a limited extent. The work of Starr[6] showed that the hydrogen ion concentration of saliva varies directly with the alveolar carbon dioxid tension and the carbonic acid content of the blood rather than with the hydrogen ion concentration of the blood, and is increased by fatigue and decreased by emotional excitement. Starr also found a wide range in the hydrogen ion concentration of 610 specimens of saliva from 228 normal healthy subjects, the p_H ranging between 5.75 and 7.05, although the range in 86 per cent of these specimens was between p_H 6.35 and p_H 6.80. Now, the hydrogen ion concentration is merely a measurement of the concentration of the dissociated hydrogen, or of the actual acidity. The titratable acidity is another property of the saliva, which measures not only the actual acidity but also the potential acidity, and includes both the dissociated and the dissociable hydrogen. Moreover, the saliva, like all liquids, may be acid to one indicator and alkaline to another indicator. Thus, saliva usually is acid to phenolphthalein,[7] which is colorless with acids, and red with alkalis and has a p_H range of 8.3 to 10.0. It usually is alkaline to para-nitrophenol,[7] which is colorless with acids and yellow with alkalis and has a p_H range of from 5.0 to 7.0. Lastly, the volume of standard acid or alkali consumed in the titration of a definite volume of saliva in the presence of a given indicator is dependent, in part, on the concentration and nature of the buffer compounds of the saliva. The salivary factor of Marshall and its determination are based on these chemical principles. This salivary factor and its possible relationship to immunity and susceptibility to dental caries has been studied by Marshall[8] and by Shepard and Gies.[9]

The occurrence of dextrose (*d*-glucose) in the saliva has been a subject of dispute. Updegraff and Lewis[10]

6. Starr, H. E.: J. Biol. Chem., 54:43-64 (Sept.) 1922.

7. Clark, W. M.: Determination of Hydrogen Ions, Baltimore, Williams and Wilkins Co., Ed. 2, 1923, pp. 84, 92.

8. Marshall, J. A.: Am. J. Physiol., 36: 260-279, 1915; 40:1-11, 1916; Dent. Items Int., 38:116-127, 1916.

9. Shepard, L. A., and Gies, W. J.: J. Allied Dent. Soc., 11:275-296, 1916.

10. Updegraff, Helen, and Lewis, H. B.: J. Biol. Chem., 61:633-648, 1924.

tested sixty-eight specimens of saliva from healthy men and women for the presence of dextrose. While a few of the specimens yielded a decidedly positive qualitative reaction, the amount present was so slight that it could not be determined quantitatively even by use of the delicate procedure for the determination of the dextrose content of the blood. The great majority of the specimens contained no dextrose. In a later communication, Updegraff[11] concedes that sugar may be eliminated in the saliva in some advanced cases of diabetes.

Updegraff and Lewis[10] also determined the total solids, total nonprotein nitrogen, urea nitrogen, ammonia nitrogen and uric acid content of human saliva from normal individuals. They also analyzed the blood of these subjects. Their results indicated that "the activity of the salivary glands would appear to be selective, since of the blood constituents, glucose and amino-acids are not secreted in significant amounts in the saliva, while urea and uric acid readily pass into the secretion."

The urea content of the saliva has clinical significance. Schmitz[12] analyzed simultaneously the blood and the saliva from forty-five cases representing various pathologic conditions. He states: "The urea content of saliva averaged 89.4 per cent of that of the blood. Salivary urea determinations may be employed in determining the functional activity of the kidneys where for any reason it is impracticable to obtain blood specimens."

The biochemistry of the thiocyanates (sulphocyanates, sulphocyanids, sulfocyanates, sulfocyanids) has been the subject of an extensive research by Kahn.[13] A further study of thiocyanates in their possible relation to dental caries was made by Gies, Lieb and Kahn,[14] who found that "salivary sulfocyanate appears to be wholly excretory in character and significance." Sullivan and Dawson[15] have reported a decrease in the thiocyanate content of both the saliva and the urine of patients with active pellagra.

The chief protein of the saliva is a mucin, which has been studied in great detail by Lothrop.[16] According to Kirk,[17] mucin, which is precipitated by secreted lactic acid, plays a prominent part in the formation of bacterial plaques on the teeth.

At least one vitamin (fat soluble D, the antirachitic vitamin) plays a part in the metabolism of calcium and phosphorus. Consequently, vitamins may be expected to participate in the processes of calcification and to have a dental relationship. The diet in its relationship to the teeth is discussed and the literature reviewed by McCollum and Simmonds.[18]

Another vitamin (water-soluble C, the antiscorbutic vitamin) protects the animal organism from scurvy. Its absence from the diet gives rise to the

11. Updegraff, Helen: Dent. Cosmos, 68:237-239 (March) 1926.

12. Schmitz, H. W.: J. Lab. & Clin. Med., 8:78-82 (Nov.) 1922.

13. Kahn, Max: Dissert., Faculty of Pure Science, Columbia University, 1912.

14. Gies, W. J.; Lieb, C. C., and Kahn, Max: Dent. Cosmos, 56: 175-197, 1914.

15. Sullivan, M. X., and Dawson, P. R.: J. Biol. Chem., 45:473-488 (Feb.) 1921.

16. Lothrop, A. P.: J. Allied (Dent.) Soc., 7: 410-428, 1912.

17. Kirk, E. C.: Dent. Cosmos, 52:729-737 (July) 1910.

18. McCollum, E. V.: The Newer Knowledge of Nutrition, Ed. 3, New York, The Macmillan Company, 1925, pp. 472-493.

typical symptoms of scurvy, including the oral symptoms. Detailed accounts of this vitamin, in its relation to biochemistry and nutrition, are given by Funk and Dubin,[19] Sherman and Smith,[20] and McCollum and Simmonds.[21]

The relation of the endocrines to calcium metabolism and the teeth has been discussed by Taylor[22] and by Sajous,[23] who have paid especial attention to the suprarenals, thyroid, parathyroids and thymus.

Gies and his collaborators[24] studied the influence of various endocrines on the teeth of young albino rats in the process of development. Their results suggested that "possibly the thyroids normally tend to induce *deficient* (subnormal) calcification of the teeth, and the parathyroids normally tend to induce correspondingly *excessive* (supernormal) dental calcification."

Anesthetics may produce chemical changes in the blood and the urine. The earlier literature on this subject has been reviewed.[25]

The clotting of the blood is the result of several chemical reactions. The blood plasma contains fibrinogen (a protein), calcium salts, and two antibodies, antiprothrombin and antithrombin. These antibodies prevent intravascular clotting. They probably have their origin in the liver. The blood platelets and, to a lesser extent, the leukocytes, contain a zymogen known as prothrombin or thrombogen. The blood platelets and the tissue cells in general contain a thromoplastic substance or cephalin-protein. When a vessel is cut or injured, the thromboplastic substance combines with the antiprothrombin. The prothrombin is now able to react, and is converted into active thrombin, the clotting enzyme, by the action of the calcium salts. The thrombin immediately acts on the fibrinogen and coagulates it to insoluble fibrin, which forms the clot. This theory is essentially that of Howell.[26] Should any component required in this series of reactions be present in the blood in an abnormally small amount, the coagulation time of the blood is increased, and postoperative bleeding is more pronounced and more prolonged. The administration of calcium salts, and the local application of cephalin, thrombin and similar biologic products are purely chemical methods for the treatment of such a condition.

The examples just given demonstrate the value of a knowledge of biologic chemistry to the student of dentistry. In addition to a comprehensive course in biologic chemistry, the dental curriculum should also include a course in applied dental chemistry devoted to the *chemistry* of such subjects as dentifrices, their composition, and their action on the oral tissues and secretions; dental cements; dental metals, alloys, and

19. Funk, C., and Dubin, H. E.: The Vitamines. Authorized Translation from the Second German Edition, Baltimore, Williams and Wilkins Co., 1922, pp. 297-311.

20. Sherman, H. C., and Smith, S. L.: The Vitamins, Chemical Catalog Company, New York, 1922, pp. 95-156.

21. Footnote 18, pp. 171-198.

22. Taylor, J. M.: Dent. Cosmos, 63: 227-230 (March) 1921.

23. Sajous, C. E. de M.: Dental Cosmos, 65:702-713 (July) 1923.

24. Gies, W. J., and collaborators: Dent. Cosmos, 59:1258-1241 (Dec.) 1917.

25. Hepburn, J. S.: Disc., Dent. Cosmos, 59:455-459 (April) 1917.

26. Howell, W. H.: A Textbook of Physiology, Ed. 9, Philadelphia, W. B. Saunders Co., 1924, pp. 446-469.

amalgams; dental porcelain, and other materials used in the practice of dentistry.

CONCLUSION

The prospective student of dentistry should receive as much instruction as possible in chemistry, including organic chemistry, prior to admission to the dental college. The dental curriculum should include instruction in biologic chemistry and in the applied chemistry of dentistry. The knowledge thus acquired will be of service to the student in his study of other required subjects, and in the practice of his profession.

DISCUSSION

John A. Marshall, San Francisco, Calif.: Biologic chemistry, as Dr. Hepburn remarks, is based upon inorganic, organic and physical chemistry. Furthermore, it is closely associated with bacteriology, as shown, for example, in the reactions which bacteria produce in culture mediums; indeed, in the very preparation of the culture mediums. Its relation is no less close to pathology and therapeutics. Some of you may be thinking that biochemistry does not help a dentist to prepare a cavity or to make a crown, and if we are to regard these operations merely from the standpoint of technical detail which requires skill, but not much original thinking, then I grant that you are correct. But I hope that we are not in entire accord with those who maintain that dentistry is 90 per cent technic. It is in the realization of the advancement which the science is making that biochemistry plays its part. The dentist repairs an organ which is not functioning properly; the repairs are necessary to insure the comminution of food. But consider the patient. He has been educated, through popular science literature, regarding the recent advances in the science of nutrition. The patient expects his dentist to know a good deal about the relation of food to teeth and health. Where is the dentist to get his information? From the popular press, the scientific journals, or his patients? How many dentists today are equipped to read through a scientific article on this subject unless they have at least a fundamental knowledge of biologic chemistry? They should be able at least to distinguish between a protein and a fat. It would be well if they knew something concerning the theories of the action of vitamins and something of the mechanism of calcium metabolism. If they employ local or general anesthetics, they would find it interesting and helpful to be familiar with some of the biochemical theories which are advanced for the explanation of anesthesia; for example, the differences between nitrous oxid anesthesia and ether. In addition, a knowledge possessed by the dentist as to some of the principles of biochemistry would have an interesting effect on the advertising literature with which the overworked practitioner is surfeited. Such a knowledge might influence the manufacturer to modify his statements to a closer semblance to truth. I hope that the committee instructed to report to the House of Delegates on this matter of advertising will have some constructive suggestions to offer as well as money to put them into operation. The practical application of biochemistry to dentistry is unquestioned. It does not enter every operation, but the operations in which it does enter are important. Let the student be supplied at least with the rudiments of the subject; it is not the intention to make the dental student a biochemist any more than it is to make him a jeweler or a ceramist. If the practitioner wishes to specialize, that as a matter of future development, but the least that can be done for the student is to acquaint him with a few outstanding biochemical facts and illustrate their application.

SOME IMPORTANT CHANGES IN THE PRACTICE OF BRIDGEWORK*

By F. B. VEDDER, A.B., D.D.S., Ann Arbor, Michigan

IT is probable that the branch of the healing art known as dentistry had its inception somewhere in remote antiquity in the extraction and replacement of missing teeth. The premature loss of teeth is as old as the race itself, and there is historical evidence that crude attempts to restore these lost organs were made long before the Christian era. While various methods to restore or to replace teeth lost prematurely have come down to us from the very beginning of civilization, it is only within a comparatively recent era that, from these crude restorative operations, that branch of the practice of dentistry known as bridgework has evolved.

The progress and development of bridgework is so closely related to all forms of dentistry that it would be practically impossible to trace its growth as a separate entity, and as progress in dentistry as a whole has been largely dependent on and directed by progress in dental education, it is well perhaps, at this time, to discuss briefly some of the changes that have taken place in dental education, and to trace the effect of these changes on dentistry as a whole and in particularly on bridgework.

Up to the middle of the nineteeth century, there were no dental colleges in existence. Dentistry was considered a mechanical trade, and men entered the field through the preceptor or apprentice system. After the beginning of the nineteeth century, many who entered the practice of dentistry were also practitioners of medicine and practiced dentistry more or less as a speciality of medical practice. This had a tendency to bring dentistry into close relationship with medicine, a relationship so apparent that the founders of the first dental college made a number of unsuccessful attempts to have dentistry taught as a specialty of medicine in one of the medical colleges. The failure to accomplish this has had an important bearing on the development of dentistry in this country, as it marks the beginning of the separation of dentistry and medicine.

The first dental college, established in Baltimore in 1840, was entirely independent of any medical college, as were all of the dental colleges that sprang into existence in the two or three decades immediately following. Until close to the beginning of the present century, practically all of the dental schools in this country were independent and proprietary, entirely divorced from medical influence and lacking any kind of university affiliation or control. Owing to its lack of association with other forms of education, dental education at first was largely training in technical arts, offering no fundamental

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general training, and an inadequate knowledge of the medical sciences. The curriculums of the great majority of dental schools consisted almost entirely of courses in the mechanical phases of dentistry, and American dentists became noted for their superior skill and ability in the mechanical aspects of the practice of dentistry. As the fundamental medical sciences became more highly developed, especially in the fields of bacteriology, histology, anatomy and physiology, a few dental colleges added to their curriculums courses of instruction in these subjects. This is perhaps the beginning of the movement to place dentistry upon a biologic basis, a movement that developed very slowly at the outset, but which has assumed immense proportions, and has greatly altered the entire scope of dentistry within the last two decades. It is only comparatively recently that dental educators and leaders of the profession have come to realize that dentistry is fundamentally something more than a highly skilled mechanical trade; that it is, rather, a branch of the healing art, and as such must have as firm a biologic foundation as medicine and surgery. Its practitioners, then, in order effectively to meet the problems of modern practice, must have as thorough training in the fundamental medical sciences as in the technical phases. As it has become more and more apparent that dentistry is a part of general health service, there has been rapid development, not only in the practice of the profession, but also in the training of the men who enter its ranks. Fortunately, the tradition of fine mechanical skill that was fostered and developed before the addition of the biologic sciences as a part of dentistry has not been lost. Rather has it been enhanced, and the entire scope of dentistry has been broadened to meet the rapidly changing conditions and the rapidly increasing responsibilities that have come as a result of this newer conception of dental practice and has become so closely related to medicine that the two must have practically the same educational foundation.

The earliest dental bridges known were apparently constructed for esthetic effect alone. They consisted of pieces of bone or ivory carved to represent the teeth they were to replace and were held in position by means of wire twisted about the remaining natural teeth. This crude method of replacing lost teeth, the precursor of modern fixed bridgework, was undoubtedly the only method used until the introduction of partial dentures. Partial dentures covered practically the entire palate, or mandibular ridges, and were commonly made of gold or silver, being retained by adhesion alone. The use of clasps followed later. Retention by means of clasps was such a decided improvement over retention by adhesion alone that the supporting base was made smaller and smaller as the use of clasps was continued. It was soon noted that clasps were, in many instances, injurious to the supporting natural teeth, and that the bases frequently were the cause of severe gingival disturbances. These untoward effects were considered necessary evils, and while attempts were made to correct the condition, little was done to prevent it.

After a number of years, during which partial dentures, either with or without clasps, were used as the only means of restoring lost teeth, the gold crown was introduced to the profession. At first, crowns were used as individual units, either to restore badly decayed

teeth, or as a means of adornment. It was later found that missing teeth could be replaced by attaching artificial ones, first gold and then porcelain, to these crowns, without using a base resting upon the underlying tissues for support.

The introduction of the all-gold crown and, later, the porcelain faced crowns, and their use as attachments for bridges, marks an important advance in the development of the practice of bridgework. Introduced as they were at the beginning of the period previously mentioned, when practically the entire purpose of dental education was the development of skill in the mechanical arts, their almost universal use as attachments for bridges created a veritable avalanche of fixed bridgework and led to the rapid development of this form of replacing missing teeth. The widespread use of pulpless roots offered almost unlimited opportunity for the exercise of fine mechanical skill and ingenuity. It was during this period that the profession introduced some of the fine technical procedures that have been constantly developed and that today form the foundation for the mechanical arts in the construction of modern dental bridges. Although the bridgework of this time left much to be desired from the standpoint of health and hygiene, it stands as a monument to progress in a fine mechanical art.

It is important to note that, during this period of tremendous growth in the technical aspects of dentistry, practically all bridgework was based upon pulpless teeth as abutments. The question of possible deleterious systemic effect on an individual from the retention of pulpless teeth had not been raised. As a matter of fact, it was at this time that such leaders of the profession as Goslee, Broomell, Rhein, Bunting and others were writing on the advisability of removing the pulps of teeth in order to stimulate the circulation of the peridental membrane as a prophylactic measure. In the light of present-day knowledge, we are inclined to wonder that the profession could ever have been guilty of such practices, and yet how logical it is that, for a time, such methods of practice should have been in vogue. While dentistry in this country developed independently of medicine, it grew with the growth of medical science, and its advancement throughout shows the influence of medical progress. Many of the earlier practices of medicine are no more crude than the earlier practices of dentistry. After centuries of work in perfecting the mechanics of practice, and in developing cures for the symptoms of disease, medicine has turned its attention only within the last two decades to the development of methods of diagnosis and prevention.

In the early part of the present century, the attention of both the medical and dental professions was called to the pulpless tooth as a possible causative factor in systemic disease. The reaction to the discovery that some pulpless teeth were involved in systemic disorders was rapid and far-reaching. Immediately and without waiting for more mature investigation, a large number of physicians and dentists denounced all pulpless teeth and advocated their immediate removal. In the severe storm of denunciation, it seemed, for a time, that all forms of dentistry employing pulpless teeth were to be swept away. Since practically all of the fixed bridgework up to this time employed pulpless teeth as abutments, this form of operative procedure was almost universally condemned. It is probable that

all of the fine mechanics developed by the older forms of bridgework would have been lost had not the laity, who had suffered so severely from ruthless and indiscriminate extraction, demanded of dentistry something other than partial dentures, and had not the casting technic been introduced to the profession at that time. For some time after its introduction, the cast gold inlay was used largely as a substitute for foil. Owing to imperfect cavity preparation and inadequate methods of casting, the use of pure gold was necessary to secure safe margins, and while pure gold inlays were occasionally used as attachments for bridges, their use was not attended with any great degree of success. Those who had followed the development of bridgework and appreciated the weight of criticism against the pulpless tooth realized that, if fixed bridgework was to remain as an accepted form of dental practice, it must be placed on vital teeth as abutments, and to attain this end the development of the gold inlay offered the greatest possibilities. The early use of the inlay in bridgework was attended with many failures and disappointments, but these failures showed the way to a greater appreciation of the problems involved in using the inlay as a bridge attachment. It soon became apparent that the inlay did not possess so wide a range of application as did the various types of crowns and that its very nature demanded a more careful study and a more thorough diagnosis of the conditions presented if its use as an attachment was to meet with any degree of success. Today, the inlay bridge has passed the experimental stage. We know that, within certain limitations, the inlay attachment, if properly prepared, will withstand the stresses placed on it; will protect the tooth, and will preserve the vitality of pulps as well as anything available at the present. It is true that many inlay bridges fail, but these failures are usually due to poor judgment and faulty execution. It is regrettable that many who possess sufficient ability and skill in execution lack the judgment and foresight that are such necessary qualifications of modern bridgeworkers. The demands made on bridgework have increased proportionately with the knowledge that the teeth and their condition play so important a part in the general health of the patient. No longer can bridgework be considered a purely mechanical art; the requirements of health and hygiene demand a thorough knowledge of the biologic factors underlying the use of an artificial structure in the mouth of an individual. It must be admitted that a dental bridge is a potential source of danger to the individual who wears it, a danger that must be minimized and outweighed by the benefit that it produces, if its existence is justifiable.

The increasing responsibilities of the bridgeworker have made necessary a more careful study and a more comprehensive diagnosis of all cases presented. This diagnosis cannot be made without a thorough knowledge and understanding of the purposes for which bridges are applied, and the objectional features attending their use. Undoubtedly, the restoration of function is the main purpose of a dental bridge, not only masticatory function, but also all of the functions performed by the natural tooth; such as the preservation of the natural form of the arch and of facial contour, the preservation of proximate contact, and, by proper occlusion, the prevention of the elongation of the

opposing teeth. Occasionally, the restoration of esthetic effect is, from the standpoint of the patient, a more important purpose of a dental bridge than the restoration of function. This is especially true of anterior restorations where little is required for function but the maximum degree of esthetic endeavor is demanded.

Among the objectional features attending the use of bridges may be mentioned the inevitable loss of tooth tissue involved in the preparation of attachments; the occasional loss of teeth due to overload and improper occlusion; the death of pulps from thermal shock; the irritation to the investing membranes, and to the subjacent mucosa from crowded proximate spaces; the improper fitting of pontics and saddles, and the establishment of conditions that render efficient mouth hygiene impossible. It is a regrettable fact that many of these objectional features have been overlooked in the past in the construction and application of bridges, and the attendant failures have subjected all forms of bridgework to criticism that might have been withheld if certain mechanical and physiologic requirements had been observed. In the careful and intelligent diagnosis that should precede the construction of a bridge, not only should all of the mechanical and physiologic requirements be taken into account before the decision is made as to the course of procedure, but there should also be a definite plan in the mind of the operator as to what the next step would be should the contemplated procedure prove a failure. In regard to the choice of method, it should be constantly borne in mind that there is no one best method that is applicable to all cases. Conditions are so different and individual variations so great that they cannot be forced into a uniform mold or pattern, to be met by a single course of procedure.

For some time, there has been a discussion in regard to the merits and disadvantages of fixed and removable forms of bridgework. Removable bridgework, a development of the partial denture idea, was introduced to eliminate some of the more objectional features of the fixed bridge, especially in regard to cleanliness and the distribution of load. That many fixed bridges are insanitary is a fact that has long been apparent, and many have felt that structures so devised as to permit removal from and cleansing outside the mouth would be cleaner than a permanently fixed structure. The fact that many fixed bridges are unclean is due to faulty design and construction rather than to fixation. Removable bridges are just as susceptible to poor design and construction as are the fixed type, and because of their very nature are more likely to be neglected by the careless patient.

The more enthusiastic exponents of removable bridgework have severely attacked the principle of fixation, advancing the argument that most of the ills of fixed bridgework were due to immobilizing roots and placing on two or three roots the work of a greater number. The claim is frequently made that certain forms of removable bridges allow practically free movement of the abutment teeth, and that, by use of specially designed saddles, most of the load of mastication placed on the bridge is carried by the soft tissues rather than by the abutments. If it were possible to place part of the load carried by a bridge on the soft tissues and maintain that condition over long periods of time, removable bridgework would possess a

great advantage over the fixed type of structure. This condition has not been met, especially in cases of relatively short span, where saddles must necessarily be small. In them, there is a tendency toward constant resorption of the tissues beneath a small saddle, and, sooner or later, the load carried by the bridge will rest entirely upon the abutments or the saddle will have settled to such an extent that the bridge is no longer an aid to mastication.

The principle of fixed bridgework has been criticized because of the danger due to overload produced on the abutments. Such overloads may be avoided by properly constructed fixed bridges and by the intelligent selection of the roots to be used as abutments. Certain teeth, because of the shape of their roots or because of the lack of bony support, are not suitable as bridge abutments if they are to bear any considerable amount of stress. This is especially true of the lower incisors, the upper lateral incisors, the upper second bicuspids and, in some instances, the upper first bicuspids and central incisors. Not only are the roots of these teeth frequently ill adapted to withstand unusual stress, but also, in many instances, the crowns are of such form as to render them unsuitable for the application of vital attachments. Moreover, the preparation for vital attachments often requires so much destruction of tooth tissue that, in young patients especially, there is danger of pulp degeneration from thermal shock. Under these conditions, it is often advisable not to use these teeth, but rather to extend the bridge to the molars and cuspids, which, in most cases, are admirably fitted for bridge abutments.

A typical example of this is seen in cases in which an upper first bicuspid is to be replaced. In older patients, when occlusion is normal, and no teeth are missing from the opposite side of the mouth, a bridge replacing the first bicuspid may be attached to the second bicuspid and the cuspid. It is rare that such ideal conditions exist. The bicuspids frequently decay and are filled early in life, and because of the small size of their crowns, any considerable amount of decay is likely to destroy so much dentin that it is extremely difficult to prepare an inlay or vital attachment that will have sufficient strength. The crown has been so weakened by the removal of the dentin that there is little available retention. If there is any doubt as to the advisability of removing the pulp and filling the canals, preparatory to the use of a crown, it is often more advisable to extract the second bicuspid, and to use the first molar and cuspid as abutments. It may be argued that the second bicuspid should be utilized as long as it will stand, and then a second bridge should be constructed, utilizing the molar. The danger of such a procedure is that, if the second bicuspid gives way, the cuspid may be broken or damaged to such an extent that it cannot be used again as an abutment, without devitalization.

A consideration of the advisability of using a root as an abutment for a bridge should include the direction of the forces to which it will be subjected. Some roots will withstand considerable force applied in one direction, but will promptly become loosened by much less force from another direction. The case that I have just mentioned will perhaps illustrate this point. The pressure exerted during mastication has a tendency to force the upper cuspid upward, outward and slightly forward.

Any root that is attached to the cuspid by a bridge will be subjected to movement in the same directions. The second bicuspid root, flattened as it is, mesiodistally, does not resist force in the mesiodistal direction as well as in the buccolingual direction, and if this mesiodistal force is pronounced, the attachment of the bicuspid root is likely to be impaired. On the other hand, the first molar, with its long lingual root and two buccal roots, is well adapted to withstand force from practically all directions, without injury.

Because of differences in the direction of their movement during function, it has been contended that teeth of different function should never be rigidly tied together by means of a bridge, and the use of the so-called loose joint attachment for these cases has been advocated. The loose joint, while very useful, has serious limitations. When it is used, practically all of the stress is placed on the tooth to which the pontic is rigidly attached, and, for that reason, its use where more than one tooth is to be replaced is usually contraindicated. If there is any amount of movement of either of the abutments, the loose joint is likely to wear, become loose and be a source of constant annoyance to the patient. While there can be no doubt that the application of fixed bridgework results in a partial immobilization of the abutment teeth, clinical experience has demonstrated, without question, that, within reasonable limits, certain teeth may be restricted in their movements without injury to their pulps and without inviting pathologic changes in their supporting and investing tissues, and that, in many cases, restriction of movement is actually beneficial.

The use of saddles resting upon the soft tissues and bearing a portion of the load placed upon the structure has long been an important feature of removable bridgework. It is rather difficult to draw a definite line of demarkation between removable bridges and partial dentures. According to a generally accepted classification, all structures that rest chiefly upon the soft tissues, employing the natural teeth for retention alone, are considered as partial dentures; while those in which the load is distributed between the soft tissues and the remaining natural teeth are known as removable bridges.

As has been previously mentioned, there is a tendency for small saddles to settle, owing to the resorption of the tissues supporting them. Consequently, such an appliance may function as a removable bridge, a fixed bridge or a partial denture, its function depending on the character of its attachments and the amount of resorption that may take place. Clinical observation has shown that the rapidity of resorption beneath a saddle is in inverse ratio to its size. For this reason, there is a marked difference in the usefulness of upper and lower saddles. Upper saddles, especially, when used with a palatal bar, may be extended to cover larger areas of mucosa, and consequently will be attended by less resorption. In spite of the forces of gravity, they are frequently more stable, more comfortable and more efficient than similar appliances on the lower arch. Lower saddles that are not supported at the heel or posterior end frequently settle rapidly, and unless adequate provision is made for this settling, not only do they become ineffective as an aid to mastication, but also, by their leverage, place too much stress on the teeth to which they are attached. The proper outline

of saddles, either upper or lower, and their method of attachment to the remaining natural teeth is a problem that requires careful study. When used, as they frequently must be, with an attachment at but one end and with a lingual or palatal bar, they may, by their leverage, exert tremendous stress on the abutment teeth in directions which the teeth are ill adapted to withstand. The method of attachment of saddles has been under discussion for a long time. In spite of the fact that we have developed the gold inlay to what we feel is a high state of perfection for the fixed bridge, we have not yet developed an attachment that may be placed on vital teeth and that is entirely satisfactory for removable bridgework. The split pin and tube and the telescope crown, two of the strongest attachments for removable bridges, require the use of pulpless teeth, and while there are a number of patented attachments on the market intended to be used in connection with inlays in vital teeth, none possess sufficient strength to withstand the stress and wear placed on them by large saddle cases. When the cast clasp was introduced, it was thought that its more perfect adaptation to the tooth would free it from most of the objectional features of the older forms of clasps. The cast clasp has not solved the problem. While it has a field of usefulness, it possesses many objectional features. Practically all clasps tend to wear the enamel of the teeth on which they are placed, and, in many mouths, clasped teeth show a marked tendency toward decalcification beneath the clasp. Not only are clasps frequently injurious to the teeth: the very nature of their form and the materials from which they are made render them susceptible to frequent breakage when subjected to constant stress.

In the outlining of removable bridge cases, one is often confronted with the necessity of making a decision between the use of small inlay attachments or clasps, or the use of pulpless teeth and attachments that may be expected to withstand heavy stress and long wear. Occasionally, the presence of one or more suitable pulpless teeth that may be retained within the field or on the opposite side of the mouth will solve the difficulty. There are those who will oppose the use of pulpless teeth as abutments under any conditions. This objection arises from personal interpretations that have been made of the recent discussion of the relation of infected teeth to general health. I yield to no one in my appreciation of the significance of dental and peridental infection, but I am not willing to accept the dictum that all pulpless teeth are infected. Experiences in the clinics and the laboratories of the University of Michigan have given cogent proof that, by proper root canal medication and filling in selected cases, pulpless teeth may serve as abutments for bridges without any evidence of danger to the individual.

This paper, which has been largely a capitulation of certain factors in bridgework, is given for the purpose of calling attention to certain fundamental principles which are involved in replacement of teeth by artificial substitutes. In consequence, I am led to conclude that modern bridgework cannot be stated in terms of empiricism or uniform procedures, but, rather, must be directed by a full appreciation of all factors involved, and the adoption of a plan of action that best meets the needs of the individual case.

DISCUSSION

Albert J. Irving, New York City: It is refreshing to listen to a paper on bridgework which smacks of the sciences of biology and physiology rather than technical procedures. Dr. Vedder has given us such a vast store of intelligent information and material for reflection that an adequate or just discussion could not be given in the time allotted. This discussion will deal principally with the keynote of this excellent paper, which is embodied in the closing paragraph and which is of paramount importance in the practice of bridgework: Too much emphasis cannot be placed on the thorough diagnosis of existing conditions, and the planning of a course of procedure which best suits the needs of an individual case, when teeth prematurely lost are to be replaced with artificial substitutes. If the condition of the teeth, investing tissues and the occlusion were carefully determined and charted, together with a conscientious survey of radiograms and study casts, we should all arrive at the same conclusion in the diagnosing of existing conditions of a case under advisement for reconstruction. Yet, as in medicine, surgery, and other branches of our own profession, there are times when the plan of action for an individual case may and does differ in the minds of some of our best thinkers, and their results may be more or less uniformly successful. The utterly miserable and unscrupulous manner in which much bridgework is done cannot be taken as a criterion for criticizing a method or system. When a discourse of this nature is presented, only the results of the finest and best types of mechanical skill should be before us. We must admit, however, that many of the failures in bridgework, be it of the fixed or removable type, are due not to inferior technical ability or craftsmanship, but rather to a poor analysis and design. We must also admit that, as bridgeworkers, often our main thought is merely to bridge a span or fill a gap, with little or no regard for the facts which Dr. Vedder has mentioned. Unquestionably, one of the outstanding fallacies in the practice of modern bridgework is the failure of certain men, or groups of men, to comprehend or be in sympathy with the findings and teaching of others. We often find these men setting up as their standard and basis for all procedures in replacing lost teeth a certain method or system which makes the strongest appeal to them. It then follows that the greatest percentage of successful cases is credited to those who intelligently analyze their cases, and who have at their command, and are able to execute, all the accepted forms of bridgework. Because of the shortness of their roots, abnormally shaped crowns or lack of good bony support, certain teeth are poorly adapted for bridge abutments. Dr. Vedder has mentioned that it is often wise to remove such teeth, and extend the bridge to teeth that are better fitted to withstand undue stresses. By making a careful diagnosis and design, often a plan can be evolved whereby these less desirable teeth may be utilized, and the contemplated structure may give years of service, unless the abutment teeth are hopelessly diseased. The patient should always be acquainted with the circumstances surrounding such a procedure, and, in most cases, he will be heartily in accord with the plan, even though he may be promised but a year or two of service. Should a bridge be attached at one end to a tooth in the class just mentioned, and at the other end to one of the more desirable ones, and should the weaker one fail, there is little danger of fracturing the stronger one, provided the preparation of the abutment is made along certain lines, and sufficient protection to the cusps is provided for. Dr. Vedder made a statement which is worthy of much consideration. "There should also be a definite plan in the mind of the operator as to what the next step would be should the contemplated structure prove a failure." If, for example, this contemplated structure were to extend from upper cuspid to first molar, and should fail, we would be faced with a perplexing and serious problem. The opportunity for success in a bridge of this or any type is far greater in a patient who has reached maturity than in young patients. In all cases in which teeth are lost in young people, it seems to me more rational and surely conservative to supply these teeth temporarily with saddle pieces, or small partial plates, until the patient has reached maturity. Since a bridge is a potential source of danger, as Dr. Vedder has said, there would be less jeopardy to the abutments and remaining teeth, and a greater opportunity for carrying the patient through life without subjecting him to an extensive partial or full denture, should a plan based on conservative and sound thinking be applied.

INTERDENTAL CANALS*

By ISADOR HIRSCHFELD, D.D.S., New York City

IN the interpretation of radiograms of the mandible, the inferior dental canal and the mental foramen must be differentiated from pathologic radiolucent areas. Abnormally large bone spaces, which occur quite frequently in the alveolar septums and lower down in the body of the bone, must also be taken into consideration. In addition to these which are quite well known to the dental profession, there are two vertical radiolucent streaks in the anterior part of the mandible which are rather frequently interpreted incorrectly as indicative of a pathologic condition. It was the frequent appearance of these radiolucent streaks in radiograms and their constant similarity in form and position that led me to believe that they also are a normal anatomic feature. After making a study of them, I brought out the fact, in a preliminary report, that these radiolucent streaks are produced by canals or channels, which, because of their radiographic interdental location, I termed interdental canals. Subsequent study proved that anatomically they are constant and that they contain anastomosing vessels of considerable size.

*Read before the Section on Anatomy, Physiology, Materia Medica and Therapeutics at the Seventh International Dental Congress at Philadelphia, Pa., Aug. 24, 1926.

It is not without some trepidation that I venture to describe and call attention to these interdental canals, for it seems hardly plausable that there should still be, at this late date, a constant feature in the human anatomy that has not yet been pointed out. However, no less than eighteen textbooks on general anatomy, special dental anatomy, and dental radiology, American and European, published or revised since 1920, have been conscientiously searched for references to such canals, without success. Then, too, a survey of current dental literature was made, with inquiries of expert radiologists. I feel safe in saying that, to the dental profession, the interdental canals are practically unknown. This fact was an added incentive in my efforts to obtain more detailed data on the anatomy and function of these channels.

RADIOGRAPHIC DESCRIPTION

These radiolucent streaks are found one on each side of the mandible between the central and the lateral incisors, where they start variously at some point near the apical half of the roots. In some cases, they run quite far down, but, in others, they fade out rather abruptly only a short distance beyond the apices of the teeth.

The upper end of the radiolucent line is usually quite distinct (Fig. 1),

and may be seen to terminate occasionally in a circular shadow caused by the canal's foramen, which is situated on the lingual alveolar plate (Figs. 2 and 3). In some cases, this upper end appears to be continuous, toward the crest of the alveolar septum, either with a series of emphasized bone spaces (Figs. 4 and 7), or with a pathologic rarefaction progressing apically (Fig. 8). The latter picture in its ensemble, on first observation, I regarded as possibly an osteorarefaction caused probably by pyorrheal infection or mechanical trauma. I am aware of instances in which such misinterpretation resulted in negative prognosis and unnecessary extraction of teeth.

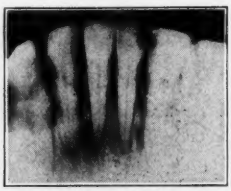

Fig. 1.—Radiogram of interdental canals with well defined upper end.

Fig. 2.—Radiogram of interdental canals distinctly showing circular shadows caused by the foramina at their upper end.

These canals vary radiographically, in different individuals, in length, width, and degree of radiolucency (Fig. 9). Furthermore, improper technic in radiography may modify their appearance so as to either change their identity or entirely eliminate them. Hence, a canal may appear almost as short as it is broad, and if, coincidentally, the radiolucency overlaps the apex of an adjacent tooth, it may give the optical illusion of periapical destruction (Fig. 10). The op-

Fig. 3.—Radiogram of interdental canals distinctly showing circular shadows caused by the foramina at their upper end.

Fig. 4.—Apparent continuation of the lower, lighter part with the upper, darker part of the line. As a matter of fact, anatomically, these are separate entities. The upper part of the interdental canal is situated lingually to the enlarged bone spaces higher up. (Compare Figures 1 and 2.)

erator should bear this in mind, also the possibility of other optical illusions, central incisors (Fig. 13), and also two others, one on each side between the

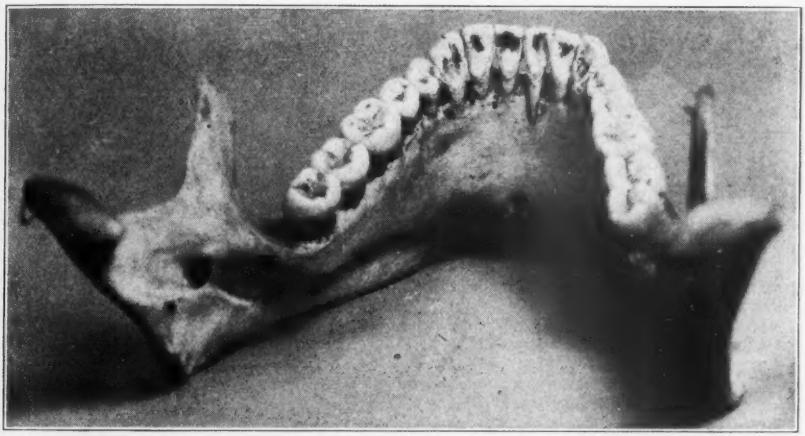

Fig. 5.—Lingual aspect of mandible radiographed in Figure 4, showing the foramina of the interdental canals. On the left side, there are three small foramina instead of one larger one as on the right. These enter the same canal only a short distance beneath the surface.

when he studies radiolucent areas in the lower incisor regions (Figs. 11 and 12).

Besides the two interdental radiolucent lines described above, occasionally an additional one appears between the

Fig. 6.—Mandible shown in Figure 4 with wires run through the interdental, mental and the inferior dental canals.

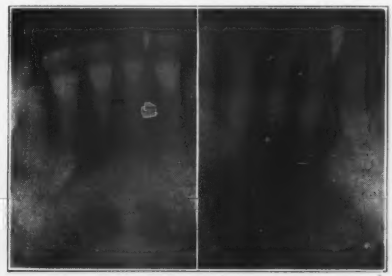

Fig. 7.—Left: Another instance of a radiographic illusion. The canals seem to merge with the enlarged cellular spaces but actually do not. Right: A foreshortened radiogram of the mandible shown on the left, showing complete separation between the upper and lower radiolucent spaces. It is interesting to note that there are small communicating foramina between the two, evidently for the transmission of branches of the vascular contents of the canals into the spaces above.

lateral incisors and the cuspids. In such event, three, four or five canals can be seen in radiograms of the lower anterior region. Because of their comparatively infrequent appearance, these additional canals might be considered as supernumerary.

Fig. 8.—Radiogram in which the upper end of the interdental canal merges with the radiolucent part of the radiogram, giving the impression to one not familiar with the anatomic character of these radiolucent lines, that they are extensions of the pathologic process above.

ANATOMIC DESCRIPTION

By sectioning a number of mandibles, the fact was brought out that the interdental canals differ also anatomically. Starting invariably with a well-formed foramen in the lingual plate of the alveolar process at some point between the apical half of the central and lateral

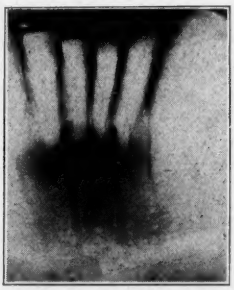

Fig. 9.—Extraordinarily conspicuous interdental canals with indications of wall structures. This radiogram also gives evidence of supernumerary interdental canals as well as showing faintly the canals leading to the apical foramina of the teeth.

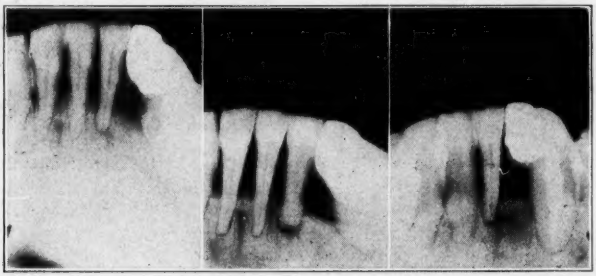

Fig. 10.—Left: Radiolucent area near apex of the right central incisor. Center: An area immediately under the apex. Both radiograms can easily be misinterpreted as evidence of periapical infection, but they are both the results of improper angulation in radiography. Right: Same part taken at a different angle, showing the definite character of the interdental canal and its independent relationship to the tooth.

incisor roots (Figs. 15-20), they dip down obliquely through the cortex into the cancellous part of the mandible,

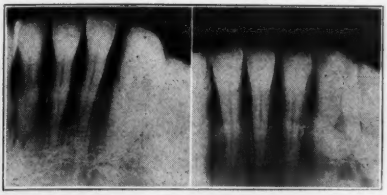

Fig. 11.—Several lower teeth, showing closeness of the canals to the teeth, the peridental lamella only intervening. If an actual pyorrheal condition coexisted above it, the extent of destruction might be overestimated.

where they take on different structural forms. In a small percentage of mandibles, the canals have well-defined solid walls for a short distance beyond their foramina and then become sievelike owing to the numerous minute openings that communicate with the surrounding bone spaces. Further down,

Fig. 12.—A radiographic illusion of a pathologic process beyond the root apices, the result of the crooked posture of the central incisors which places the apices immediately in front of the canals instead of mesially to them.

they become more porous and meshlike; then, they completely lose their identity as canals and fuse in with the maze of trabeculae (Figs. 21 and 22). In other mandibles, the sievelike structure is retained down into the body of the bone, broadening out gradually into a gourd-shaped formation, its broadest anteroposterior diameter extending, in

Fig. 13.—Supernumerary interdental canal between the central incisors.

some instances, from the labial to the lingual cortex (Fig. 23). Here, the communicating holes may be found large and with rounded edges. In the lower part of this gourd-shaped cavern, a prominent opening is seen, through which a terminal branch of the con-

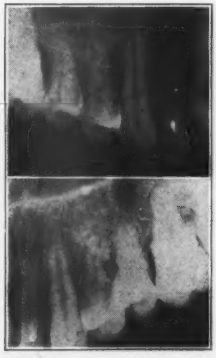

Fig. 14.—Supernumerary canals sometimes, but seldom, observed in radiograms of upper anterior region.

tents of the inferior dental canal passes (Fig. 24).

The checking up of the mandibles, sectioned with their respective radio-

Fig. 15.—Foramina of supernumerary interdental canals in addition to those normally found. These may be observed quite frequently.

Fig. 16.—Typical interproximal relationship of the foramina of the interdental canals.

grams, leads one to believe that the majority of mandibles do not contain wall enclosed canals. They may have either open channels through which the contents pass straight downward or there may be no well-defined channels because the vessels take an irregular, tortuous course through especially large bone spaces slanting down at different angles (Fig. 25). The former con-

Fig. 17.—Multiple foramina leading to the interdental canals in deltoid formation.

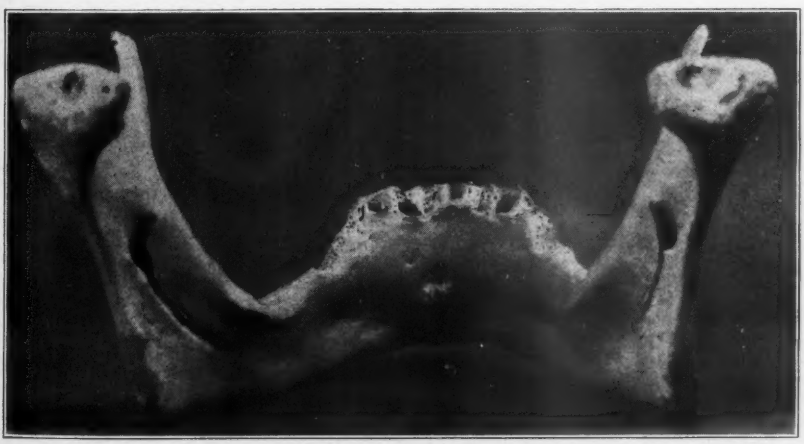

Fig. 18.—Destruction of one of the foramina by a suppurative process, the other remaining unscathed.

Fig. 19.—The alveolar socket of the left central incisor in the mandible illustrated in Figure 17. The distolingual side has been destroyed, including the upper part of the interdental canal. This, it will be observed, leaves a macroscopic opening of considerable size leading to the deeper cancellous structure of the bone.

Fig. 20.—Edentulous mandible showing the tendency of the canals to remain open in spite of the complete loss of the alveolar process.

dition may produce a distinct radiolucent line, while the latter, which is the predominating one, produces none at all. Naturally, therefore, we find no radiolucent lines in most radiograms.

Fig. 21.—Section of mandible with part of lingual plate removed to expose the structural character of the canal, which, in this case, is cribiform like that of the inferior dental canal. Immediately above this is the foramina, which has been left intact.

Thus, in an examination of 200 sets of radiograms of various mouths chosen at random, only sixty (about 33 per cent) showed these canals. However, the absence of the interdental canal, either radiographically or anatomically,

Fig. 22.—Large interdental canals with distinct wall formation, indicated by the long white lines.

does not imply that the vascular contents which they transmit are absent. On the contrary, a study of more than

Fig. 23.—Longitudinal anteroposterior cross-section showing distinctly the open character and large size of some interdental canals. The pin projects from the foramen of this canal. A consideration of the open anatomic character of this bone structure helps one to realize the important rôle which immunity plays in fighting deep pyorrheal infection, and also the folly of attempting to eliminate the infected part completely by radical operation.

200 mandibles showed a constant presence of the formina; which indicates that the anastomosing vessels are a constant and not an incidental feature.

History. It was found that they are a widely distributed mammalian characteristic. The brevity of this paper does not permit a detailed enumeration of the

Fig. 24.—A thin section cut off from the left part of the mandible in Figure 22, showing at *X* the opening through which the incisal branch of the inferior dental artery enters the interdental canal.

FUNCTION

In an effort to ascertain the frequency with which the interdental foramina appear in other animals, I examined the mandibles of many groups at the American Museum of Natural

findings of each group, but an outstanding observation was that, in the anthropoid apes, the foramina are con-

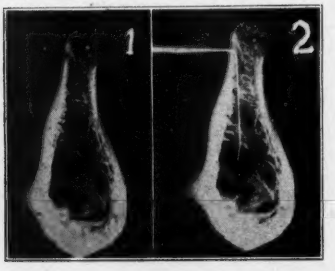

Fig. 25.—Left: Anteroposterior section, showing the shortness of a wall structure in this instance. Right: A wire extended down into the canal through the foramen.

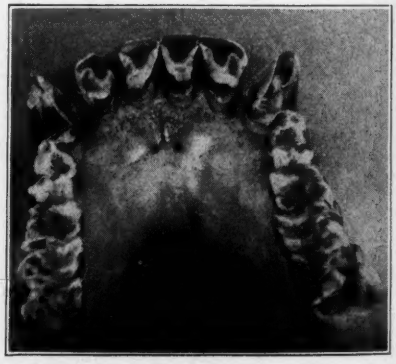

Fig. 26.—Foramina opening into the interdental canals in the mandible of a chimpanzee.

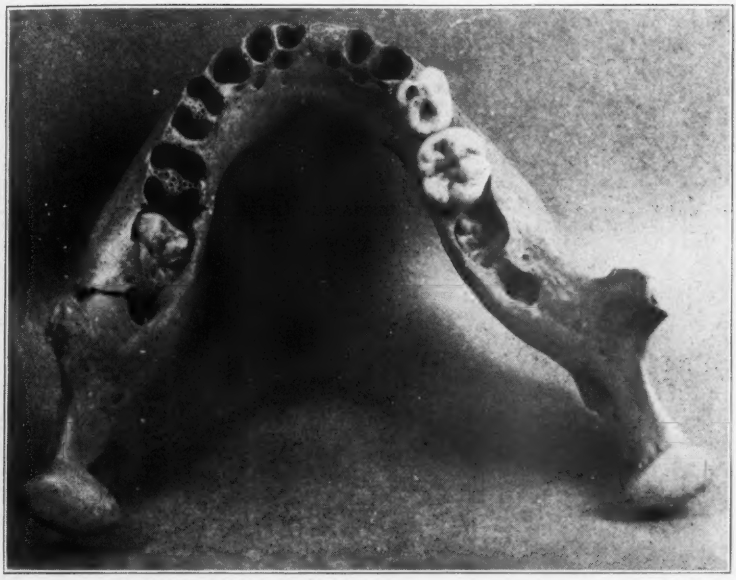

Fig. 27.—Mandible of a child whose temporary teeth were still in position at the time of death; whose permanent anterior teeth were yet to erupt through the holes lingually to the temporary ones. The characteristic distolingual relationship of the foramina of interdental canals to openings through which the permanent central incisors were to erupt may be noted.

Fig. 28.—Mandible of a young orang-outang with temporary teeth still in position. Position of interdental foramina in relation to openings for eruption of permanent central incisor may be noted. This relative position is similar to that in Figure 26.

stant, and decidedly human in appearance (Figs. 26-28). According to William K. Gregory, associate in Physical Anthropology, at this Museum,

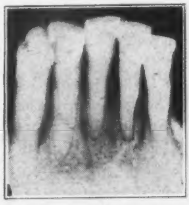

Fig. 29.—Wet specimen used for dissection. The bent white line is caused by the radiopacity of the injected material in the end of the sublingual artery below the point where it enters the foramen of the interdental canal.

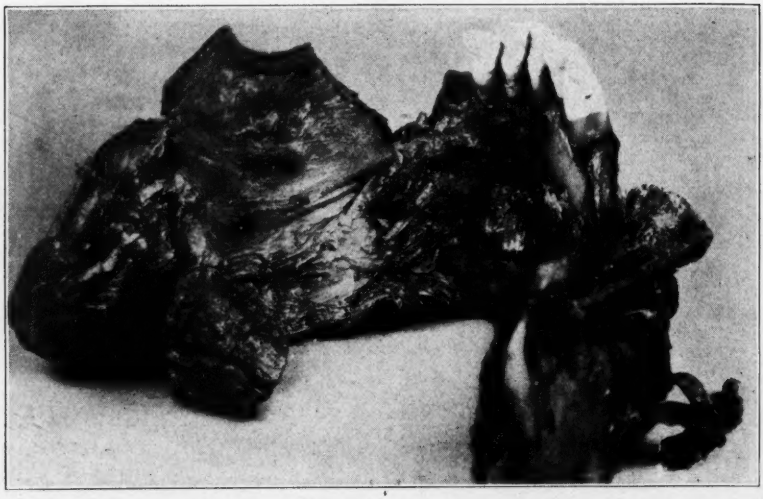

Fig. 30.—Dissection showing the course of the left sublingual artery. It runs up through the mucoperiosteal tissue, and, just before it enters the interdental foramen, gives off branches, which seem to supply the septal tissues between the adjoining teeth. (In a dissection of an orangoutang at the Museum of Natural History, I have been able to trace these small branches, macroscopically, to interproximal marginal gingivae.) On the right side, where the periosteum is removed, the end of the artery on that side can be seen entering the foramen. In this illustration, the suglingual artery has been retouched on the photograph for sharper definition.

Fig. 31.—Original photograph used in Figure 29, before retouching of the course of artery.

who so kindly piloted me through the examination of the various groups, the frequent occurrence of the foramina in these animals indicates that they may be considered to have decided morphologic significance.

Dissection of a wet specimen disclosed the fact that the canals and foramina transmit an anastomosing vessel between the inferior dental and the sublingual arteries. (The textbooks referred to above make no mention of this anastomosis.) (Fig. 29.) The terminal branch of the former runs up from the lower part of the body of the mandible through the interdental canal, gives off a dental branch mesially a short distance below the level of the apex of the central incisor for the supply of that tooth and its pericementum, and proceeds up to and through the foramen, where it forms a loop with a terminal branch of the sublingual artery in the mucosa on the lingual side of the mandible (Figs. 30-34).

Fig. 32.—Dissection of the labial side of the specimen shown in Figures 29 and 30. The cortex as well as some of the cancellated substance and its narrow contents have been removed in order to trace the branch of the inferior dental artery, which is here seen to run up to near the symphysis and then turn upward and pass through the interdental channel to the foramen, which is noticeable in this photograph. As it passes through the foramen, it forms the anastomosing loop with the terminal branch of the sublingual artery. The vessel in this photograph has been retouched for sharper definition.

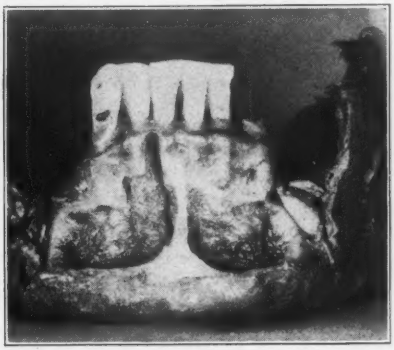

Fig. 33.—Retouched copy of Figure 32.

PRACTICAL APPLICATION

A thorough acquaintance with the anatomic characteristic of the interdental canals and formina has its practical application, especially in the differential diagnosis of various pathologic radiolucent areas. 1. The canal may appear either with or without the circular radiolucent markings of the foramen. 2. The foramen may appear alone, i. e., without a canal. 3. Through improper angulation, either one or both may be distorted in shape and relative position. 4. Radiographic illusion may cause them to appear as continuations of nearby pathologic osteorarefactions. (Figs. 35-37.)

The two radiolucent markings registered by the interdental canals or foramina, because of their characteristic location in relation to the incisors, are

faithful guides in the identification, in the radiogram, of the incisor teeth, and may often aid in the recognition of broken down roots, or of teeth in which the incisal edges are not included in the radiogram. They may also aid in the recognition of worn down cuspids which in radiograms occasionally simulate incisors in outline. Lack of space necessitates the omission of additional suggestions, but I hope

Fig. 34.—Usually, both foramina are approximately on the same level. Occasionally, one is situated somewhat lower than the other. In this mandible, the difference in their level is the greatest that I have had occasion to observe. The large size of both foramina apparently indicates the size of the vascular structures passing through them.

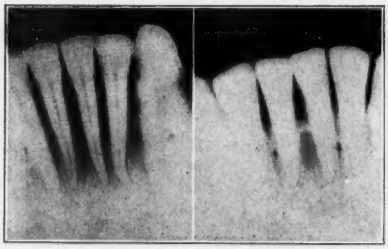

Fig. 35.—Left: Radiogram in which the foramina alone appear, i.e., without the canals. Right: Radiogram in which both the foramina and the canals may be seen but the foramina are more marked.

Fig. 36.—Bone destruction between the central incisors caused by a parietal abscess. The dark radiolucent area distally to the right central incisor was interpreted as a continuation of the pathologic process around the root, a condition tending to make prognosis less favorable. Yet, when a surgical flap was made, it was found that the diseased bone did not extend so far distally. This round radiolucent area may have been caused by the presence of the interdental foramen without a canal, as in Figure 35.

that they will be brought out in the discussion.

SUMMARY

1. The linear and circular radiolucent areas described in this paper are produced by interdental canals and their foramina, respectively, which are normal anatomic features and not the result of pathologic bone destruction.

2. They may be mistaken for evidence of periodontal disease in the same way as are some of the other normal radiolucent markings.

3. A knowledge of their anatomic characteristics may serve as an important aid in diagnosis.

4. In certain instances of doubtful periapical or parietal radiolucent areas in the lower incisal region, it is advisable to take additional radiograms at different angles for the purpose of ruling out anatomic features.

5. The function of the interdental canals and foramina is to transmit well-sized blood vessels through which the inferior dental and sublingual arteries anastomose.

6. The constancy with which the foramina appear in the mandibles not only of man, but also of many other mammals, and in approximately the same relative position, suggests their functional importance.

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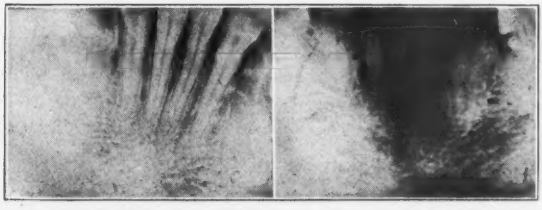


Fig. 37.—Left: A radiolucent area distally to the left central incisor near the apex, and one mesially to the right lateral incisor slightly higher up, giving the root at that point a moth eaten appearance. Both these areas certainly appear pathologic, yet in the radiogram of the same area, to the left, taken at different angle, the peridental structures seem perfectly normal. It is my belief that the seemingly pathologic conditions in the left film were only an illusion produced by the interdental canals, through improper angulation in radiographing.

Fig. 38.—Periapical area at the right lateral incisor; also well marked interdental canals. If the radiogram were made from such an angle as to bring the right interdental canal as close to the lateral incisor as the left canal is to the left lateral incisor, the long shadow would appear continuous with the round periapical shadow. Thus, a radiographic illusion of a deep extension of the pathologic destruction would be produced.

ANATOMY OF THE ROOT CANALS*

By T. OKUMURA, D.D.S., M.D., Tokyo, Japan

METHOD OF STUDY

VARIOUS methods are advocated and employed for the anatomic examination of the root canals, but, in my experience, the use of transparent specimens is best suited for this purpose, for the following reasons: 1. The original form of the root is retained. 2. The form of the canal, even its minute structure, can be shown clearly. 3. Failure in preparation of the specimens is rare. 4. The specimens can be preserved for a long time.

In 1918, a total number of 807 specimens were prepared and examined, and, recently, 1,339 were newly prepared and classified. The present report is concluded from the foregoing studies.

CLASSIFICATION OF THE CROWN AND ROOT

The crowns of teeth may be classified into superior and inferior forms. The term "superior form" is applied to to those crowns attaining the higher degree of development in certain kinds of teeth. "Inferior form" is applied to those crowns which attain the lower degree of development in certain kinds of teeth.

Either kind of crown may be subdivided into certain types according to general formation, arrangement of cusps, ridges, tubercles and grooves, etc.

The roots of teeth may be classified into three kinds of forms: simple, furcate and fused. Simple roots are those which retain their original form, based on the assumption that the anteriors should have one, the upper and lower bicuspids one, the upper molars three and the lower molars two roots. 2. Furcate roots are those of bicuspids or molars which furcate into two or more. The furcation may be total or partial. 3. Fused roots are those in which two or more roots are totally or partially fused along their length. The furcation and fusion may occur simultaneously.

The kind of root in a certain kind of tooth is subdivided into certain types according to formation, furcation and fusion.

CLASSIFICATION OF THE ROOT CANALS

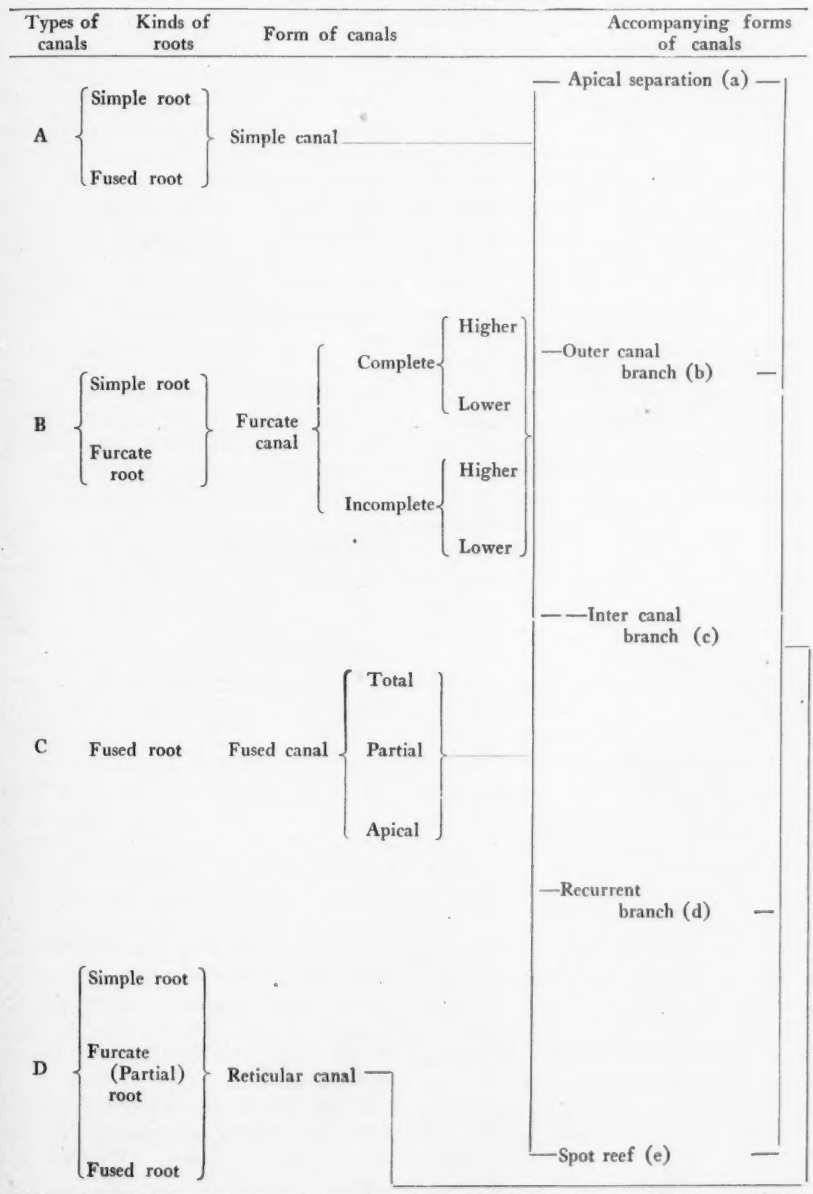
Root canals may be classified according to their morphologic relation to the roots as follows:

Type A: Simple canal. When a single canal passes through a simple root and both have the same outline, it is called a simple canal.

Type B: Furcate canal. When a canal furcates into two or more in a root, it is termed a furcate canal. It

*Read before the Section on Anatomy, Physiology, Materia Medica and Therapeutics at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

CLASSIFICATION OF ROOT CANALS



occurs either as a simple or furcate root. As an example, in an upper bicuspid when the root furcates into two or more branches, the canal will furcate accordingly. Sometimes, the furcate canal has subfurcations.

When a canal furcates at a point higher than half the length of the root, the resultant branch is called the higher furcation. When at a point lower than half the length of the root, the branch is called the lower furcation.

When a canal furcates through the whole length of the root and opens by separate foramina, it may be said that a complete furcation exists.

If a canal furcates once in the root, fuses again at a point and opens by a foramen, incomplete furcation is said to be present.

Type C. Fused canal. According to the fusion of the roots, the canals therein will fuse together. They may be called total, partial and apical fused canals according to the degree of fusion.

Type D. Reticular canal. When more than three canals run almost parallel in a root and communicate with intercanal branches, they are called reticular canals. They may occur either in simple roots, partially furcate roots or fused roots.

Accompanying each type of canal, the following forms may present themselves:

a. Apical separation. Immediately before the opening at the apex, a canal may furcate into two or more having the same or nearly the same diameter.

b. Outer canal branch. A branch canal starts at the main canal at a certain angle, and penetrates the dentin and cementum, appearing on the root surface.

c. Intercanal branch. An intercanal branch crosses the dentin, and joins the furcate canals or the simple canals in a fused root.

d. Recurrent branch. A recurrent branch starts at a main canal after penetration of the dentin and returns again to the canal. Its occurrence is less frequent than *b* and *c*.

e. Spot reef. A spot reef is a denticle in the pulp cavity presenting itself as a white spot in the transparent specimen. When this enlarges, it may cause incomplete furcation of a canal.

COMPARATIVE STUDY OF TEETH

As the crown, root and root canal have a certain relation to each other, we are able to establish certain rules by the comparative study of their types.

Upper Incisors.—The upper incisors always have single, simple canals. Among 372 teeth I examined, 17.7 per cent had apical separations and 28.1 per cent, the outer canal branches.

Lower Incisors.—In the lower incisors, the root canals sometimes furcate; usually, incompletely and in the higher portion. Among 134 teeth I examined, 11.1 per cent had furcate canals, 10.4 per cent, apical separations, and 5.2 per cent, outer canal branches.

Cuspids.—The cuspids sometimes have furcate canals. Among 95 teeth examined, 2.1 per cent showed canals with incomplete higher furcation. These furcate canals occur only in the lower cuspids, as in the case of the incisors. This kind of furcation is due to the flattening and grooving of the root, and in some instances to the furcation of the root itself, which sometimes occurs in the lower cuspids.

Upper Bicuspids.—The upper bicuspids have single, simple canals or furcate canals. Among 312 teeth examined, only one single case showed

the reticular canal; 24.3 per cent, apical separations, and 29.1 per cent, outer canal branches. In the upper first bicuspids seventy-two of eighty-five simple roots had furcate canals; for the most part, incomplete higher furcation followed by complete higher furcation. All of the seventy-four teeth having furcated roots had complete higher furcate canals, except a single case, in which the canal was simple.

In the upper second bicuspids, of forty-eight simple rooted teeth, thirty had furcate canals, mostly with incomplete higher furcation. All of the furcate roots have the complete higher furcate canals.

The canal furcations in the simple rooted upper bicuspids are due to the flattening and mesial grooving of the roots.

Lower Bicuspids.—Among 279 teeth examined, 4.6 per cent of the canals had apical separation, and 25 per cent, the outer canal branches.

In eighty-five lower first bicuspids, eighteen, or 24 per cent, had the furcate canal, with the complete higher or lower.

Among fifty-five lower second bicuspids, only a single case showed complete higher furcation.

Canal furcation in the lower bicuspids is due to the mesial, linear grooves or fissures of the roots. Sometimes, the roots themselves furcate. In the second bicuspids, those grooves occur not so frequently as in the first. Therefore, the canal furcation is rare.

Upper Molars.—Of 299 teeth of the A and C type roots examined, in which the roots are not fused, the classification of the canals is as follows:

In the mesial roots, 47.1 per cent were simple canals; 27 per cent, of complete higher furcation; 8 per cent, complete lower furcation; 13.3 per cent, of incomplete higher furcation; 1 per cent, of incomplete lower furcations, and 3.6 per cent, reticular canals.

In the distal roots, 96.8 per cent were simple canals; 0.6 per cent, of complete higher furcations; 2 per cent, of complete lower furcations, and 0.3 per cent, of incomplete higher furcation. In the lingual roots, 99.7 per cent were simple canal, and 0.3 per cent, of incomplete higher furcation.

As a whole, the mesial canals accompanied apical separations in 29 per cent, and the outer canal in 29 per cent.

The distal canals had apical separations in 14.2 per cent, and the outer canal branches in 12.2 per cent.

The lingual canal had apical separations in 7.7 per cent, and the outer canal branches in 11.7 per cent.

Two or three roots of the upper molar teeth may fuse together in the various possible ways. When the common degree of fusion occurs, the canals may communicate by the intercanal branches, and finally form the reticular canals. When the roots fuse to a remarkable degree, the canals will fuse also in the various forms and the teeth may have only one or two canals.

Lower Molars.—Of 458 teeth of the A and B Type roots examined, in which the roots are not fused, the classification of the canals is as follows:

In the mesial roots, 29.4 per cent were simple canals; 39 per cent, of complete higher furcations; 3.2 per cent, of complete lower furcation; 20.7 per cent, of incomplete higher furcation; 0.6 per cent, of incomplete lower furcation, and 6.5 per cent, reticular canals.

In the distal roots, 80.1 per cent were simple canals; 7.4 per cent, of complete higher furcation; 2.6 per

cent, of complete lower furcation; 6.8 per cent, of incomplete higher furcation; 1.1 per cent, of incomplete lower furcation, and 1.7 per cent, reticular canals.

As a whole, the mesial canals had apical separations in 27.6 per cent cases, and the outer canal branches 25.5 per cent.

The distal canals had apical separations in 21.3 per cent cases, and the outer canal branches in 16.7 per cent.

In the lower molars, buccal fusion of the roots is most likely to occur and the canals will fuse in the various ways. Not infrequently, they may form a single canal and have many apical separations.

ORAL SURGICAL ANATOMY*

By S. L. SILVERMAN, D.D.S., F.A.C.D., Atlanta, Georgia

IT has been said that surgical anatomy is no more a science than a pilot's knowledge is, and, like that knowledge, must be exact and available in moments of emergency.

The attempt to add to the sum total of what Galen, Fallopius, Eustachius, Harvey, Hunter, Meckel and other old masters contributed to the science of anatomy meets with but a modicum of success. So thoroughly have the pioneers established the science of anatomy, dissection no longer offers any unexplored regions or structures. This is particularly true of normal topographic anatomy.

Morbid or pathologic anatomy offers so many variations and surprises that any recorded deviations from "textbook anatomy" should be of special interest to the general and the dental surgeon.

The two most vulnerable anatomic structures in the field of oral surgery are the facial nerve and the facial artery. The severing of the former results, of course, in facial paralysis; of the latter, in alarming and unnecessary hemorrhage. The less commonly encountered vulnerable structures are the internal maxillary and lingual arteries, Stenson's duct and some of the sensory branches of the trigeminal nerve, principally the mandibular and the lingual nerves.

I have already intimated that nothing new can be expected in papers dealing with topographic anatomy in normal subjects. I believe that certain points I have observed in morbid anatomy may be of interest when the emergency arises. To cite one particular instance: The angle of the jaw, owing to acute infections that may involve any of the three mandibular molars, is often the site of large swellings. The swollen area involves the salivary glands in the immediate vicinity and, owing to the direction the pus has taken, it, at times, becomes imperative that drainage be established by an extra-oral incision.

I find many operators who dread to make an incision in this region because of the facial artery. My observation is this: Though it is true that the facial artery in normal anatomy lies

*Read before the Section on Anatomy, Physiology, Materia Medica and Therapeutics at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

quite near the surface (Fig. 1) in tumefied areas, the facial artery bears the same relation to the anterior border of the masseter and side of the mandible that it does in health. That is to say, it does not balloon out to follow the bulging overlying fascia and skin. Incisions, therefore, can be made without deference to this vessel. I have had the opportunity of verifying this by postmortem examination.

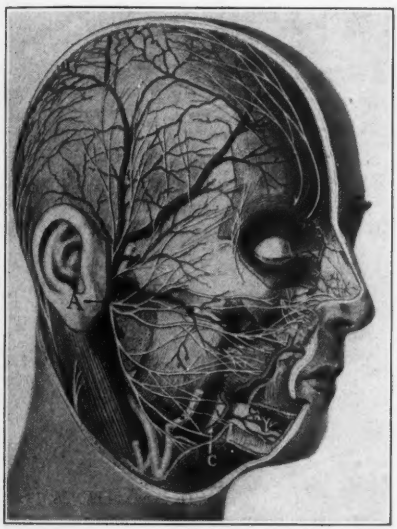


Fig. 1.—*A*, facial nerve; *B*, facial vein; *C*, facial artery. (Modified from Sabotta and McMurrich.)

What I am about to say may be elementary to the experienced surgeon, but to those who only in emergencies find it necessary to use the scalpel, I believe a word of advice is not out of place. Though it is true that the facial artery does not lie so near the surface in prodigiously swollen areas as it does in health, the scalpel is not to be sunk to a very much greater depth than in normal tissue. It is best to seek deeply situated pus without the use of cutting instruments, in the manner shown in Figure 2. By inserting closed hemostats, the pus pocket or pockets are probed and located. The hemostats are then opened, which allows free drainage.

Fig. 2.—Method of inserting closed hemostats in incision, and then opening.

Intra-oral incisions in the region of the mental and mandibular foramina may result in severance of the mental, mandibular or lingual nerves, but severance of sensory nerves can hardly be looked on as a serious accident. Aside from the numbness produced (more or less temporary), the accident is without ill effects. In fact, even the teeth in the area, though benumbed, do not lose their vitality.

The severance of a motor nerve, especially the facial, is one of the most

distressing accidents in surgery. If the entire nerve is severed, all wrinkles on the affected side are obliterated. The tears unable to enter the canaliculi flow over the cheek. The eye remains forever open. The affected side is absolutely expressionless and, owing to relaxation of the muscles, the corner of the mouth droops and drooling of saliva follows. Of course, if only a portion of the nerve is severed, only that area which it supplies will be monoplegic. The facial nerve lies close to the masseter muscle. (Fig. 1 *A*.) In order to escape cutting any portion of this fanlike nerve (in acutely abscessed conditions requiring incisions), it is wise always to make the incision below the angle and in the shadow of the jaw. The hemostats are then used to divert the pus to the desired point of exit. There are times when incisions directly over the nerve are not to be evaded.

What has been said above concerning the facial artery maintaining its usual position in tumefied areas is also true of the facial nerve. In other words, the facial nerve, because of its numerous attachments, cannot be very near the surface. Incisions in this region in nontumefied tissue can be safely made, if the fascia is first raised from the underlying structures, either by pinching it between the thumb and forefinger or by the use of a tenaculum. It is also wise to make all incisions in line with the facial nerve, rather than at right angles. Figure 3 shows the line of incision and drain in a case of necrosis involving the head of the condyle.

Fig. 3.—Line of incision and drain in a case of necrosis involving the head of the condyle.

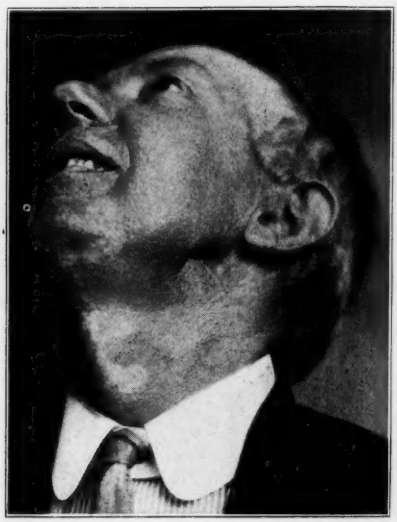


Fig. 4.—Extent of scarring after extra-oral incision.

It will be observed in this figure that the facial nerve has not been injured, as indicated by the closed eyelids and the functioning of those muscles of expression that enter into the production of a smile. The scar below the angle

Fig. 5.—Extent of scarring after extra-oral incision.

marks the original incision which I made in order to drain the entire region of the ascending and a portion of the horizontal ramus. The condition was a diffuse periosteitis, which cleared up, with the exception of a tendency to necrosis of the head of the condyle. This necessitated the incision and drain above referred to.

Figures 4 and 5 show the extent of scarring following extra-oral incisions, and the effort the patient must make in order to expose the area to view.

Figures 6 and 7 graphically show

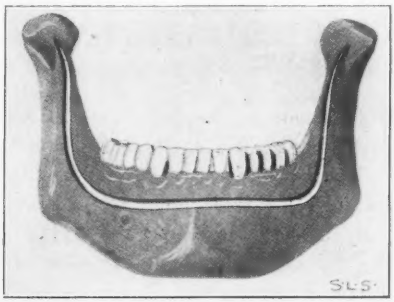


Fig. 6.—Model showing that an intra-oral incision can safely be made from the tip of the coronoid process to tip of the coronoid of the opposite side without severing any important vessel or nerve.

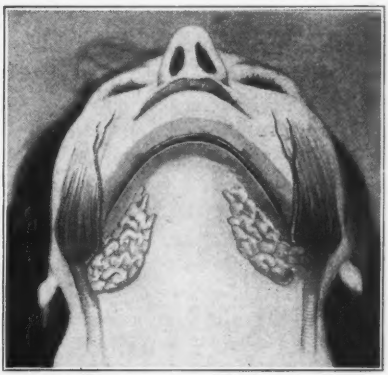


Fig. 7.—View of patient showing extra-oral incision that can be made to the bone without severing any important nerve or blood vessel.

two incisions, one intra-oral, and the other extra-oral, that can be safely made directly to the bone without severing any important nerve or vessel.

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THE IMPORTANCE OF GENERAL HYGIENE IN THE DENTAL CURRICULUM*

By WILLIAM RICE, D.D.S., D.M.D., Boston, Massachusetts

IN an article entitled "A Modern University,"[1] Dr. Abraham Flexner has included dentistry among the vocations which do not now conspicuously involve the search for truth or the training of men to carry on the search for truth.

While professional pride reacts keenly to the sting contained in this statement, if one considers it carefully, the question naturally arises as to what specialties allied to medicine have been conspicuous in the search for truth. Furthermore, have not the efforts of dentistry in the realm of research been fruitful in achievement when compared with other branches of specialized health service? As a matter of fact a large share of credit for the great advances in the knowledge of the nature of disease and of the various factors which enter into the problem of its prevention must be awarded to the biologist, the chemist, the physicist and the sanitarian.

The world of science has at last realized that of far greater moment to the well-being of mankind than combating disease already established is the attunement of life to harmonious adjustment with natural laws, and the utilization of the wellsprings of health which are always at hand. Progress is not so much delayed by a lack of knowledge as by the fact that the comprehension of scientific knowledge is limited to a comparatively small number of individuals or groups of individuals who have, as a result of intensive application, been able to grasp the significance of natural laws which have been awaiting a talisman from time immemorial. Is it not also true that the end-results of scientific achievement have been released from obscurity, only to be accepted complacently by the unenlightened mind, as valuable only as far as they promote the convenience, physical comfort or sensual stimulation, or satisfy the accumulative propensity, while but little interest is taken in their application to a broader understanding of life and to happier and more efficient living? Stoddard[2] has said, "Certainly we are better equipped, better trained, better organized for the task than ever before. The only serious drawback seems to be man's own limitations, the possible incapacity of his intelligence to understand and use aright the powers he has invoked." Glenn Frank also

*Read before the Section on Dental Education at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 2?, 1926.

1. Flexner, Abraham: Atlantic Monthly, October, 1925.

2. Stoddard, Lothrope: Scientific Humanism, 1926.

writes,[3] "Ideas are today buried under the jargon of technical scholarship, and efficiency is insulated from the contact with modern life."

The pertinence of the foregoing generalizations to the subject of this paper may not be apparent. I offer them as a premise to the main theme, the purpose of which is to emphasize the *value* to the student of dentistry of a knowledge of the general principles governing the maintenance of the health of the entire body, of which the oral structures are but an essential part. In no field of research have more satisfactory results been attained, and no field offers greater opportunity for beneficial application. Is it not the chief concern of health teaching, whether it is related to medicine, dentistry, or public health, to make available to the student the most authentic findings resulting from scientific investigation, and to aid him to translate them into their simplest terms in order that he, in turn, may intelligibly convey them to those whom he will be called on to serve? McCollum[4] has said that "the building of a strong and vigorous body with its own barriers of defense is the greatest protection we have." If this is true, it is logical to assert that the subject of general hygiene is as fundamental in education for the highest type of dental health service as are the sciences of anatomy and physiology.

Not least among the reasons for making it possible for the student to acquire authentic knowledge of both personal and public hygiene is the fact that such knowledge reacts to his personal benefit in many ways. The practice of dentistry draws heavily on the health reserves of the body while in no other vocation is redundant health and the observance of refined habits of personal hygiene more essential. An understanding of the most approved ideas relating to the hygiene of nutrition, the hygiene of action, the hygiene of the central nervous system and the hygiene of reproduction must invariably tend to promote habits of living that will not only lend zest to the enjoyment of life, but will also inspire the adoption of a well regulated régime in daily activities that will greatly increase efficiency in accomplishment.

The application of a knowledge of hygiene to the dentist's own protection connects itself so intimately with the obligations of citizenship as to make the consideration of the one without the other both unsatisfactory and incomplete.

The public is justified in inferring that the possessor of a degree in dentistry has been trained for leadership in matters relating to public health. In common with the physician and the sanitarian, he should bring to the community in which he resides the benefit of his attainments.

Turner[5] says, "The hygiene of nutrition considers the proper diet and the ill effects upon the teeth and other parts of the body arising from dietary deficiencies and irregularities. It considers the hygiene of digestion and the way in which digestion is affected by the emotions, fatigue, mastication, and various bodily states. Of particular importance

3. Frank, Glenn: Outlook for Western Civilization, Century Magazine, September, 1925.

4. McCollum, E. V.: The Newer Knowledge of Nutrition, Ed. 2, New York, The MacMillan Company, 1922.

5. Turner, C. E.: The Teaching of General and Dental Hygiene in Dental Schools.

is our more recent knowledge regarding calcium metabolism. What foods supply calcium and what foods supply the vitamins necessary to enable the body to use the calcium? What is a proper program of prenatal and infant feeding? Important aspects of assimilation such as autointoxication, elimination, oxidation, constipation, food poisoning, etc., also demand consideration.

"The hygiene of action presents two distinct sets of problems—those related to the much needed vigorous physical exercise, and those related to ordinary daily activities, such as body mechanics, seeing, breathing, bathing, and clothing. In all these matters, we should see that the living conditions for our students are such that they can develop correct habits while they are in the dental school.

"Fundamental subjects for consideration in the hygiene of the nervous system include concentration, habit, sleep, rest, neurasthenia, emotions, bodily defects and stimulants. How can the man work most efficiently? What avoidable conditions cause unnecessary fatigue? How can the neurasthenic patient best be handled?

If we consider the hygiene of reproduction as the replacement of one generation by another, this subject involves such fundamental topics as heredity and eugenics, prenatal care, infant care, and sex hygiene."

The report of the Research Division of the American Child Hygiene Association for 1925, entitled "Health Survey of Eighty-Six Cities," the chapter on organization and personnel under the heading "Professional Education of Health Officers," gives the degrees held. They are listed in the accompanying table.

PROFESSIONAL EDUCATION OF HEALTH OFFICERS

Professional Education	Full-Time	Part-Time	Total
M.D. degree only	26	37	63
M.D. plus C.P.H. or M.S. degree	2	0	2
Laymen, without professional degree	14	3	17
Laymen, with B.S. or M.S. degree	2	0	2
D.V.M. degree	1	1	2
Total	45	41	86

Is it not significant of the need of more comprehensive education along health lines in our dental schools that there are none in this list holding the dental degree, although dentists are given a place as members of the organization as are boards of health, sanitary inspectors, bacteriologists, and public health nurses? The same report, under "Conclusions," states, "The well-trained, capable, full-time health officer is the most important single need revealed by this survey. The great diversity in effectiveness, in methods and in emphasis in public health work is the result of haphazard growth, which has been for the most part without guidance, objective goals, standardized methods or balanced programs." In sixteen of the cities surveyed, the health department employed a full-time or part-time dentist. Twenty-eight cities conducted dental clinics under other auspices. While the application of knowledge of hygiene by the dentist in the fulfilment of his responsibilities to the public is of great importance, of equal moment are his obligations to those who seek his services in private practice.

The successful dentist maintains a permanency in the personnel of his practice and an established frequency of

examinations to a degree which perhaps has no parallel in other professions at the present time. It is not at all uncommon for him to see all members of the family at frequent intervals covering a long period of time. In this way, he becomes the intimate friend and trusted adviser of those under his care. Particularly in matters of health, his advice is solicited, with the confidence and belief that his opinion is based upon a general knowledge of hygiene, and that he has kept abreast with the findings of modern research.

Is this confidence always justified? Are not the dentist's answers frequently warped by his own personal belief? Is he not prone to draw conclusions based largely on his personal experience? If the answers to these questions are in the affirmative, the situation is untenable; and herein lies another unanswerable reason for giving a place of prominence and an adequate allotment of time to this subject in the dental curriculum.

In his presidential address on the "Physician and Patient of the Future,"[6] given at the last meeting of the American Medical Association, Dr. Phillips says, in speaking of the change in present-day medical practice

> The physician of the past was educated to treat disease. He knew little of preventive medicine, or sanitation or hygiene, nor did his medical education provide such knowledge.
>
> The new era in medicine which the physician of the future must be prepared to enter must also rest on the foundation of a wide and comprehensive plan of "personal and public health education." The scheme of undergradute medical education should be reconstructed to include in its curriculum as a prominent feature the science and art of health conservation, and the art of applying the principles of the science of medicine through the personal relationship of the physician and his patient. The undergraduate student must be trained to treat the body from the standpoint of health as well as that of disease.

Is not dentistry also without the portal of a similar field of usefulness, and can it not more effectively correlate its effort with other branches of health service by the adoption of a broader and less circumscribed attitude toward the many problems involved in the establishment of a widespread and intelligent regard for the principles underlying both personal and public health?

In view of the newer findings of the histologist with respect to the histologic structures of the teeth and the wide prevalence of structural defects which offer a fertile field for the development of caries, is not the greatest opportunity of the dentist of the future to be found in the practical application of the principles of hygiene to the health of children coming under his care, and in treating these defects before actual disease is present? The day of the periodic health examination has arrived, and the public is rapidly responding to the logical reasoning on which it is based.

The adoption of this régime has been the rule in dental practice for many years: shall we not broaden its scope?

6. Phillips, W. C.: J.A.M.A., 86: 1259 (April 24) 1926.

THE INFLUENCE OF SPEECH HABITS ON THE DESIGN OF FULL ARTIFICIAL DENTURES*

By RUSSELL W. TENCH, D.D.S., New York City

DENTURE prosthesis has come to its present state of excellence through concentration of the profession on the study of articulation and impression taking. Esthetics has had some attention, but not so many men have vied with one another to produce beautiful dentures as have striven to outdo one another in the field of either impression technic or design of articulators.

It is the purpose of this paper to direct attention again to one of the temporarily overlooked issues that, occasionally, are of such importance that they defeat the skill of the articulation expert and the impression wizard who does not give them cognizance.

The tongue, the organ of speech chiefly concerned with the modification of sound into syllables and words, often exerts a decided influence on the design of artificial dentures.

Notwithstanding this fact, appliances both of the nature of partial dentures and of that of full dentures are being constructed every day in which appearance and mastication are the only issues to which any thought is given.

Speech is essential to human activity, and when it is impaired or impeded by appliances that might have been designed to avoid this impediment had exact knowledge been available, the victim of this carelessness is to be heartily pitied.

It is to be desired that those who have the teaching of denture prosthesis at heart and who devote their time to it may be able to get together, compare notes and disseminate information on this subject that is accurate and usable.

This paper stresses only the tongue actions that affect the design of full dentures. The tongue is, as a rule, a rather adaptive organ, but instances in which it is not frequently come to our attention.

We should therefore, be on our guard lest we expect too much of it and involve ourselves in endless labors as a result of our overconfidence.

When natural teeth are present and the tongue is in a passive condition, it fills the cavity surrounded by the teeth and hard palate. In speech and in mastication, the upper half of the anterior third of it functions above the level of the lower dentition.

In the designing of full dentures, the tongue action should be observed and the mandibular teeth so placed that they will not require that the tongue be consciously elevated in order to function. As a rule, the mandibular denture should not occupy more than one half of the space existing between the edentulous ridges—a little less if possible.

I have observed that patients having a small tongue rarely experience any difficulty in acquiring proficiency in the use of artificial dentures even though the mandibular ridge may be narrow

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

as to lateral or anteroposterior width, and thin and high, or altogether flat. In fact, no difficulty has so far been encountered when the tissue covering the mandibular ridge was so thin and dense as to prevent my best efforts to effect a good degree of atmospheric pressure retention for the mandibular denture.

On the other hand, the greatest difficulty in securing comfort for edentulous patients has been experienced when the tongue was broad and of full rounded form, and almost completely filled the cavity of the edentulous mouth.

In two instances recently encountered, the employment of the Gysi cross-bite molar-bicuspid arrangement has solved the problem of the stability of the mandibular denture in speech and eliminated complaint of lack of stability of this denture in mastication. In both of these cases, the relation of the mandibular ridge to the maxillary ridge was such as to favor a normal setting of the posterior teeth from the point of view of stability only.

It might be maintained that, in time, the patients in question could have mastered the use of dentures built in the normal way, but, in answer to such a hypothesis, let me say that eight or nine months elapsed in both instances before the change that remedied the trouble was made, with no improvement in the behavior of the dentures up to that time, although various changes in vertical distance between the ridges were tried. The ability to learn or acquire new habits of speech or mastication is entirely lacking in some people, even those of great intelligence.

Another difficulty encountered that probably has its origin also in a habit of speech aided by anatomic peculiarities lies in the tendency of some patients to use the tongue in speech and swallowing in such manner that the dorsal surface of the tongue is retracted, in swallowing and in speaking, below the level of the posterior mylohyoid ridge and engages the distolingual flange of the mandibular denture, unseating it when the tongue returns to its normal rest position. This difficulty has been partly overcome for such cases by employment of the cross-bite arrangement of the molars, the tongue being thus given all the space possible. The lingual flanges of the dentures were thinned to a minimum and fashioned so as to present no perceptible line of junction between the denture and the surface of the mandible.

All cases of this type encountered had broad ridges of medium height. That speech habit played a part in the tongue action was assumed from the observed action of the tongue in speech, together with the fact that all these patients spoke Hebrew or German, or both, as well as English.

While I am not a linguist, I believe that the Hebrew language, and perhaps also the German language, favors a development of the posterior part of the tongue and requires it to function in a way that might produce the peculiar difficulties related.

In considering the tongue actions that might influence the design of artificial dentures, the sounds especially interesting to the prosthetist are the subtones, which are produced by the voice, and modified by the organs of speech. Of the subtones, the labiodentals f and v, as in "fit" and "vote," and the linguodentals th, as in "thin," l as in "lay," t as in "tin," d as in "do," s as in "sin," and z as in "zinc," are of particular interest. The facility

and clearness with which these tones are produced by those wearing artificial dentures depends much on the manner in which the incisors, cuspids and bicuspids are placed in the two dentures.

Pelsma, in "Essentials of Speech," says, "Some people never use the lips in articulation." In such cases, it is obvious that the suggestions to be offered may not be of much value. However, such instances are not usual and they probably present unusual dental conditions that do not add to the attractiveness of the appearance, such as extreme prominence of both groups of incisors with great overbite and overjet, preventing the contact of the upper lip with the lower lip.

The labiodentals f and v are usually pronounced with the lower lip touching the incisal ends of the maxillary incisors. This fact may be used to advantage in many instances, as Dresch and Peters and Wright have pointed out, to determine the length of the maxillary incisors. The position of the incisors should be so modified that they finally touch the lower lip lightly at about the top of the vermillion border when the patient says, "Very fine."

During the formation of the linguodental sound th as in "thin," the tip of the tongue touches the incisal ends of the maxillary incisors as well as the incisal of the mandibular incisors. It does not protrude beyond the labial surfaces of the incisors.

When the sounds of t, d, s and z are produced, the tip of the tongue makes a contact either with the linguogingival portion of the hard palate or with the linguogingival surface of the incisor teeth. The difference between the tongue contact required to produce the th sound and that required to produce the other linguodentals can be used to indicate the anteroposterior position of the maxillary incisors.

If "thin" is pronounced "tin," the maxillary incisors are not sufficiently prominent and so will need to be shifted forward. Additional evidence of this is the fact that the tongue, in its initial contact with the incisors, may project forward under the incisal edge of the maxillary incisors. The fact that, in the attempt to say "thin" or "fourth," the tongue, when forming the th sound, does not come forward enough to touch the maxillary incisors usually indicates that these teeth are placed too far forward.

Incidental to the production of the th sound, and also sometimes the sound of f or v, is an exaggerated anteroposterior movement of the mandible, encountered in patients who have a retreating chin, accompanied, as it usually is, by a decided overjet and overbite of the natural incisors. This overjet is responsible for the development of this movement, as the mandible must be brought forward to permit the mandibular incisors to assume an end relation to the maxillary incisors in order to produce the th sound clearly.

This speech relation of the mandible to the maxilla of edentulous patients of this type is many times confused by dentists with the central occlusion position of the mandible, which is distal to the position just described.

The clear formation of the other linguodentals will require different treatment for different cases. As a rule, when teeth have but recently been extracted, the thickness of material behind the maxillary incisor teeth should be kept reduced to a minimum.

When the factors previously referred to have been carefully utilized, it may be that a patient of the nonadaptive

type will still find difficulty in producing sounds such as s in "so." This may be an indication that the type of tooth used is too thick. If a long bite tooth is used, the thickness may be reduced by grinding the lingual surface; if not, a tooth of longer bite should be substituted.

Short bite, thick incisors have had a great deal to do with producing impaired speech of edentulous persons. There is no possible excuse for the use of such forms in view of present knowledge. Notwithstanding this, they are used in great quantities, with resulting impairment of appearance, and masticating and swallowing functions, as well as of speech.

The sibilant s final after d, n and t, as in "sands," "persimmons" or "plants," is perhaps more obvious when imperfectly formed than any other, because of the whistling effect produced, and when not due to error in the anteroposterior position or to the thickness of the maxillary incisors may be due to the maxillary arch's having too great a diameter from the lingual side of the first bicuspid to the lingual side of the first bicuspid on the other side.

The column of air that produces s must be expelled over the middle of the tip of the tongue. The sides of the tongue, in this action, usually make a pressure on the linguoclusal side of the bicuspids and first molars, preventing lateral escape of air and facilitating control of the escaping air, which produces the hissing s-s-s, so that it may be abruptly stopped.

If the contact of the tongue with the bicuspids cannot be readily made, the s sound will often be imperfectly formed. The remedy is to sacrifice the appearance a little by narrowing the arch in the bicuspid region or to use bicuspids one or two sizes larger than required and grind them to the mesiodistal dimension needed. This will permit getting about the external appearance needed and will also assist in reducing the distance between the lingual cusps, permitting the production of a clear final s sound.

I have hinted that the instability of dentures, especially mandibular dentures, may be due to the tongue action required to produce sounds incidental to certain languages. That this is so seems possible. It would be interesting to hear what a careful student of denture prosthesis, who is also a linguist, could find out in proof or disproof of this assumption.

To put all that is possible of artistry and skill into full denture service makes necessary a minute special study of the peculiarities and needs of the individual patient. It may, under present conditions, require the construction of more than one set of dentures before the solution of an individual case may be accomplished.

If we could have a concerted effort of those engaged in this specialty to record unusual conditions met with, as well as their solution, if such was found, we might, in time, be able to tell more exactly, with one examination of a patient, what the outcome might be. At least, we might prevent the unprofitable waste of time involved when dentists assume the responsibility for failures in this field occasioned by peculiar, but not immediately recognizable, conditions presented by some denture patients.

The time may come when a knowledge of tongue movement in function will be deemed quite as important in denture prosthesis as a knowledge of mandibular movements.

116 Central Park South.

THE APPLICATION OF THE MONSON SPHERICAL PRINCIPLE TO FULL DENTURES*

By H. B. WASHBURN, D.D.S., St. Paul, Minnesota

A SITUATION of tremendous importance develops the moment an edentulous patient seeks the services of the general practitioner or the prosthetist. On the one hand, we have the patient, all anxiety, wistfully hopeful that some miracle can be performed to produce a substitute for the lost organs that will restore the natural appearance, will function satisfactorily and will be generally comfortable. To one who has not lost the organs of mastication, there can come but a small appreciation of the predicament such a patient is in. All about him, he observes, possibly among members of his own family, among friends and acquaintances, those who have lost the natural teeth and are wearing artificial ones. He sees all sorts of monstrosities and hears many complaints, all of which have produced a feeling of doubt concerning the outcome of the new venture.

On the other hand, we know there are, among the dentists of the world, a majority who have a sincere desire to assist the edentulous patient in regaining a considerable part of lost function, appearance and comfort. Faced with the problem of restoring to Nature one of the most important organs, and fired with enthusiasm, the dentist reacts according to his training and natural ability. There are men of exceptional natural ability who apparently can approach and carry through a full denture case and produce a result as near perfection as anything of which the human hands and brain are capable. Such operators, who are rare, either do not need rules of technic to follow or have the essentials of many technics at their naturally technical finger tips, and, through what might be termed genius, give the few patients they are able to serve wonderful results.

Then there are those who are particularly interested in the higher mathematics and mechanics of mandibular movement and occlusion; which is commendable when all other essential factors of successful full denture service are not ignored. There is also the dentist who is naturally a technician and who delights in evolving and following the most complicated technics; which can be valuable if the results are not allowed to deteriorate into dentures for technic alone as against dentures for the patient.

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

It is readily understood that by far the larger number in the profession are in neither of the above mentioned classes, but, given the enthusiasm to render high type full denture service, they must of necessity follow a definite technic that has been worked out by someone who has an understanding not only of technic but also of underlying principles. With this vast majority in the dental profession, the first problem becomes one of choosing among the various conditions and changes that follow through the life of natural dentition, the more discrimination will be used in making a choice of principle and technic to follow. The point is herein emphasized that any technic, to be wholly satisfactory, must be based upon sound principles, and the principles should receive more scrutiny than the ease with which the technic can be followed. Many dentists have neglected the opportunity for adopting

Fig. 1.—Symmetrical face.

Fig. 2.—Asymmetrical face.

the many before the profession the full denture technic that offers the most scientific and at the same time the most practical basis upon which to operate. This circumstance has not produced the cooperative effort on the part of the leaders in thought concerning occlusion that the man waiting for light has been expecting. Technic and principles have been largely mixed and jumbled, with the result that there is no clear idea before the profession as to their relation to one another.

Obviously, the better knowledge the dentist has of the anatomy and physiology of the masticatory region, and of principles upon which to operate, for the reason that the principle, as presented, seemed a useless and almost superfluous affair, but, if carefully examined, many times would have been found to contain the exact thing needed for success.

Perhaps in no other department of dentistry do we find a greater urge to accomplish something out of the ordinary than in the department of full denture prosthesis. When called on to serve the edentulous patient, it seems that the more enthusiastic the dentist becomes, the more substantial is the possibility of success. The reason, no

doubt, for such a situation is the determination on the part of the enthusiastic operator to spare no pains in bringing to hand the best methods obtainable, and again there is stressed the need for study of principles before, or at least along with, technic.

The dictionary defines "principle" as the fundamental truth or basis from which rules or technics are derived or built up. For example, constructing a set of dentures by a technic that has been evolved without regard to a correct basis or principle may produce dentures precisely as the technic indicates, but not necessarily such as the patient should have. This is apparently forgotten by some dentists, for frequently it is said that "principles are unnecessary; what is needed is technic or methods for doing certain things." It is extremely important to every dentist to learn first of all whether the method under consideration is founded upon correct principles.

Some of the most evident factors concerned with the Spherical Principle are illustrated in the following figures. Figure 1 shows a symmetrical face; Figure 2, an asymmetrical face. The lack of symmetry, you will observe in this case, is due to a change in the lower part of the face, the occlusal area and below; a common thing to be seen, especially at the age when full dentures are necessary. Such deformity of the face is usually the result of a lack of levelness or trueness of the occlusion. The appearance on the outside of the face merely tells of changes or lack of balance in muscles and integument brought about by changes in the occlusion and changes in the bone.

Fig. 3.—Symmetrical face. The circle with the center at *A* is a cross-section of a sphere, and the lower line is the occlusal line.

Fig. 4.—Asymmetrical face, showing defection of lower jaw and occlusion away from "level" occlusal line.

The direct application of the spherical principle to full dentures is accomplished through a complete set of technical steps, which are carefully annotated in a textbook. The intent of this paper is to call particular attention to certain conditions faced by the dentist when he is called on to replace lost natural teeth with artificial den-

tures, and further, to show the logical part the spherical principle plays as a basis for diagnosis and operation. In Figure 3 a circle is placed on the symmetrical face of a previous illustration (Fig. 1), this circle being a cross-section of a sphere with its center at A. This arced line represents a "true" or "level" occlusion, which of necessity accompanies a symmetrical face.

Figure 4 shows a type of lower jaw deflection with the occlusal line still true to its center *A*, the occlusion with

Fig. 5.—Asymmetry with a concomitant lack of trueness of the occlusal line BB.

the mandible having moved around to a different position on the arc. Such a case, either of natural teeth just before extraction preparatory to dentures, or of old artificial dentures, when correctly mounted on the spherical instrument can be diagnosed, and a new occlusion planned that will permit the mandible to swing back to a position on the arc restoring the symmetry shown in Figure 3.

Figure 5 shows asymmetry with a concomitant lack of trueness of the occlusal line *BB*. This drawing is an exaggeration, the purpose being to emphasize a cause of asymmetry in the lower part of the face. Obviously, the problem becomes one of selecting principles and methods which, when followed, will "level" the occlusion and thereby restore symmetry to the face.

Figure 6 is one type of occlusion that is not true, mounted and ready to be studied with a pair of dividers in order that the prosthetist may determine what has occurred to produce the condition of unbalanced occlusion and facial asymmetry. The thought is

Fig. 6.—Case mounted and ready to be diagnosed.

stressed that the results expected by the patient absolutely require careful and intelligent study before steps to establish the new occlusion are taken; for without such study, the process might well be like the journeyings of a traveler who goes to buy a railroad ticket without knowing where he desires to go, with a logical end result. In other words, in the building of dentures, many an unsatisfactory result can be avoided by careful diagnosis beforehand, using a principle or basis that is adequate from both an anatomic and a

mechanical standpoint. Manifestly, no operator cares to perpetuate deformities of face and occlusion. The best scheme for gaining an adequate idea of the value of "true" or "level" occlusion is to observe patients with natural teeth or those with dentures, and, in each case, whether apparently symmetrical or not, mount casts of the case on the instrument and study the occlusion with the dividers from the center. Many other types of unbalanced occlusion than these so briefly described will be discovered, and, in each, a common sense plan for restoration will become apparent. The key to what the new occlusion should be will always be found in the old. For example, if, in either lateral bite, the occlusion is not in contact on the side opposite the working side, or if, in the forward bite, there is contact only in the anterior teeth, the operator can determine what such conditions have done to the masticatory apparatus as a whole. The task then becomes one of trueing the new occlusion to bring about a balance; and to do this the operator must decide just what basis or principle to use as a guide.

For full dentures, following the spherical principle, bite blocks or occlusal rims are constructed of hard wax of a height corresponding to the length of the lost natural teeth plus absorption of the ridges. By the use of a suitable arc plate, the occlusal surfaces of the rims are made to conform to the surface of a sphere, similar to the occlusal line of the natural teeth. These rims, attached to hard base plates, are inserted in the mouth and adjusted for the correct amount of space between the upper and the lower jaw, and the wax occlusion is so carved that the upper convex and the lower concave are in maximum contact in central and in both lateral and forward positions. A case so perfected when correctly mounted on the spherical instrument will function on the instrument in the same manner as in the mouth, and it then is only necessary to reproduce with

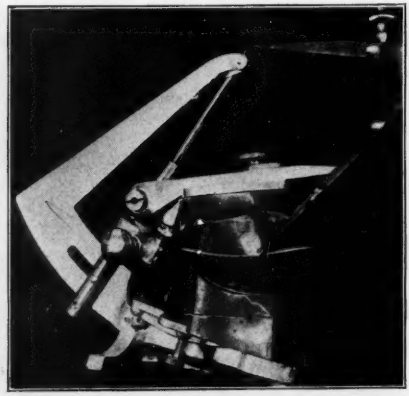

Fig. 7.—Full denture case mounted with wax rims; arc plate attached to upper ready to set lower teeth up to correct arc.

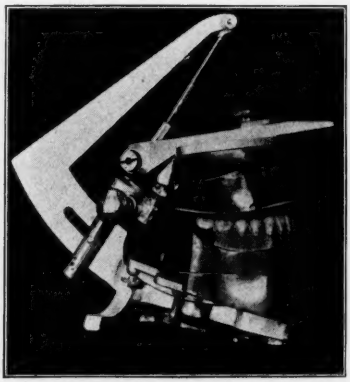

Fig. 8.—Lower denture set to arc ready to occlude upper denture.

porcelain teeth what has been built up in wax, and the result will be dentures with a balanced occlusion. In those cases of facial asymmetry resulting from a lack of trueness in the occlusion, the much desired balanced occlusion will allow a return of facial symmetry.

A factor of utmost importance that must be considered when determining natural occlusion or studying old dentures before new dentures are started has to do with the stability of the dentures. There is probably no single element that affects stability as does occlusion; therefore, it is important to produce an occlusion as nearly balanced as is possible. A balance, based upon the spherical principle, acts as a stabilizing influence of direct bearing on the success of the finished case. Further, it must be noted that a correct jaw relationship and a balanced occlusion automatically free the condyles from any previous inhibition; which means that condyles and fossae are free to return to the balanced relationship of a time when changing occlusion had not yet made its influence felt in the condyle region.

Recent research by Dr. George S. Monson discloses the fact that, prenatally, mandibles tend to develop as equilateral triangles and that they also conform to the sphere. The results of this most recent work by Dr. Monson, which will be given for the first time at this meeting, substantiate his claim for ideal occlusion, if the various interfering factors can be controlled during the period of development. The importance of research of this kind lies in the enlightenment it furnishes for intelligent diagnoses when any type of occlusal restoration is contemplated. Therefore, in preparation for full denture prosthesis, it is logical that a careful study of natural tooth arches be made in patients of various ages. Such study must not be limited to the living subject, for, obviously, much would be idle speculation unless checked from the living to a similar type in the wet or dry specimen.

There will be revealed, by such study, a close relationship between occlusion and condyles, and, further, the significance of the interdependence will become clear. For example, a very irregular occlusal line, high teeth, low teeth, extreme overbite or prognathism, or any of the many combinations of unbalanced occlusion, will be found to be associated with a compensating deviation from normal in the condyles. There may be one condyle turned forward on its neck or turned inward or outward, with the opposite condyle quite normal in shape and path, or it too may be deformed in the same manner as its mate or in a different fashion. Even a casual examination of skulls will show an astonishing variation in the type of deformity of occlusion and condyles.

The important point to keep in the foreground is that any occlusal variation from the ideal is always associated with some type and degree of deformity in the condyle region. The facts being as they are, each investigator must decide for himself to which factor to attribute the cause of the general change from ideal, i. e., does unbalanced occlusion cause deformed condyles, or do deformed condyles cause unbalanced occlusion?

It seems that the time has come in dentistry when a decision must be made by each dentist concerning the question as to whether occlusion controls the condyles or condyles control occlusion. Obviously, the decision of the operator

in this matter will influence his plan for reconstructing occlusion in his practice, and if one idea is correct, the other must be incorrect, so the ultimate result will be right or wrong, with the patient benefited or not, according to the plan followed.

If the dentist firmly believes that the condyles are the controlling factor and that an articulator must have condylar adjustments, the new occlusion must of necessity follow the operator's idea of the condyle path which he sets on the articulator, and he thereby maintains all deformities present in the old occlusion and condyle relationship.

If, on the other hand, the dentist decides that the occlusion is the all important factor, he must use an articulator that will permit him to produce a correct jaw correlation and balanced occlusion, with a feeling of confidence that the condyle will soon return to somewhere near equal and normal position when the stresses of malocclusion are removed.

The adherents of the spherical principle believe implicitly in the scientifically deduced conclusion that the occlusion is the controlling influence; that any deviation from a balance in occlusion will be manifest in some change in the condyle region to compensate; that such compenastion of condyles, if continued, will produce serious impairment of essential physiologic function; that a correction of occlusion will permit enough return to normal in the condyle region to alleviate any injury to physiologic function. There are now large numbers of practical cases covering many years of service to demonstrate the truth and logic of the matter under discussion.

WARTIME OBLIGATION OF THE DENTAL PROFESSION*

By CHARLES F. ASH, D.D.S., New York City

THE prospect of war imposes an obligation on every citizen, male or female, to do his or her part toward preparedness.

The actual declaration of war should find every loyal citizen ready to perform that duty which will best serve the interests of the nation at large. For some, this may mean enlistment in the ranks and going to the front. For others, it may mean staying at home and giving their best effort to produce the necessary supplies, by farming, manufacturing, assisting in transportation, etc.

Many of those who perform their best service by staying at home would prefer to go into active service at the front if permitted to follow their inclination. Our wartime obligation is exactly that of every other citizen; namely, to serve how and where we can do the most good.

Perhaps I can best portray my idea of the wartime obligation of the dental profession by describing something of what was done by our profession in the World War. As everyone knows, little was done in any line in the way of preparedness, by manufacturers, commercial or professional men, and perhaps still less by our Federal government.

As soon as the declaration of our entry was made, our profession was given representation on the National Council of Defense, and W. H. G. Logan of Chicago was requested to organize the Dental Reserve Corps. The story of the difficulties which he encountered will never be written. I was perhaps as close to the situation as anybody else, and I desire to take this opportunity to state that no credit which he has received or may receive can adequately reward him for the work which he performed.

The profession at large responded so promptly to the call for volunteers that very soon there were 5,000 enlisted in the Dental Reserve Corps. The enlistment of these men did not solve the dental problem by any means. Two major difficulties presented: First, many of the candidates for enlistment in the Army, Navy, and Marine Corps could not be accepted because of dental defects, and secondly, there were no materials or equipment available for use for the Dental Reserve officers.

Candidates for enlistment were in two classes as far as dental defects were concerned: (1) those who were not, but could be made, dentally fit; and (2) those who had the minimum dental requirement for acceptance but who

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needed more or less of dental repair work to make them really dentally fit.

When candidates presented for physical examination by the examining boards, they were under the supervision of the government of their respective states, and no repair work could be done for them by the federal government until they had been passed by the boards as dentally fit and had been accepted as recruits by the federal government.

Many thousands of prospective recruits were found to be physically fit except for dental defects. The state governments had no means of making these men dentally fit, and most of the men were financially unable to have the work done by their own dentists. These thousands, therefore, would have been rejected if some means had not been found to provide them with the necessary dental care. I foresaw this situation early, and a plan to take care of the emergency was presented to the dental department of the Surgeon-General's office, together with a request for the use of the postal "frank" for certain pieces of mail. This request was granted.

Some months prior to our entrance into the war, the Preparedness League of American Dentists had been formed through the efforts of J. W. Beach of Buffalo, N. Y., with the avowed purpose of enlisting as many dentists as possible, each of whom would give free dental care to the family of one recruit. Only about 300 dentists were enrolled as members, and it was obvious that, if all the dentists of the United States had enrolled, the plan would still have been inadequate for the needs.

A new plan was therefore formed, using the Preparedness League as a foundation, and calling on every registered dentist in the United States and insular possessions to give his services and materials free for at least one hour each day, to make dentally fit every man who was called on to serve his country in the Army, Navy or Marine Corps.

The hearty cooperation of the director of the draft in Washington was secured, and a letter was sent to the governor of every state, requesting him to appoint a dentist on every medical examining board.

Most of the governors responded at once, but in some cases politics interfered. This came about, in a few cases through the effort of a certain few to secure a change in the director general of their state or the director of a city, and caused considerable delay in the operation of the plan in their particular state.

It is extremely distasteful to me to state this fact, but I believe that it is for the best interest of any future situation to take cognizance of the considerable amount of interference which occurred through the petty jealousy of a few.

It is greatly to the credit of our profession that more than 18,000 dentists were enrolled in the Preparedness League, each of whom gave at least one hour a day and materials, free, to take care of the men who were passing through the draft boards. Many of these 18,000 gave as much as three or four hours every day to this work, and the result was a total of more than 1,000,000 operations without any expense to the government or to the recruits; a record of which our profession may well be proud.

A little later, dentists were appointed as members of the medical advisory boards in most of the States.

A short description of the organization might not be amiss. A director general for the United States was appointed who had general supervision of all the free dental service. A director was appointed by him for each state, and they, in turn, appointed a director for each city or subdivision in their respective states.

The volunteer dentists in each locality were indexed as to whether they would perform extractions, make fillings or bridgework, etc. When a candidate required dental care, he was sent, in turn, to the various dentists who volunteered for the kind of work needed.

One of the early difficulties was that many of the candidates refused to have the necessary work done, and the states had no means of compelling them to have it done.

This was overcome by getting up an official-looking card, which was handed to the candidate by the dental member of the examining board with instructions to visit the dentist whose name appeared on the card. With few exceptions, this plan worked, and the candidates went to the office of the dentist who was to do the work. After the work was completed, a record was made on a duplicate card of all the operations performed on that candidate. One of these cards was then sent to the local director and the other to the director general in New York. Thus, a careful record was kept of every operation, giving the name and address of the patient, the nature of the operation and the name of the dentist who did the work.

These results were not accomplished quite so easily as they can be told here. It meant many hours of work to evolve the most efficient plan for the country at large and constant further planning to take care of unusual situations which arose from time to time. In addition, there was the necessity of raising funds in addition to the $1.00 subscription, which was paid by most of the volunteer dentists, to take care of the expense of prosecuting the work.

Funds were also raised to build dental ambulances for use at the front, patterned largely after the one which was taken to France by William B. Speakman of Wilmington, Del., and with which he accomplished so much before our entrance into the World War. While these ambulances were built and equipped, none of them, I regret to say, ever reached France.

In addition to the services performed by the League, there was an enormous amount of work done by the Dental Army Corps in the various camps of the United States on men who were about to be sent abroad.

The work of our Dental Corps abroad, and the repair and rehabilitation work done in our hospitals here on returned wounded soldiers is a noble story in itself and one which cannot be covered in this paper.

In a few words, then, the wartime obligation of our profession is for every man to lay aside personal ideas or ambitions and, at once, offer his services in whatever capacity and in whatever way the country can use him for the best good of the whole cause.

CONDYLAR ADJUSTMENT: A SIMPLIFIED EQUIPMENT AND ACCURATE METHOD FOR ITS USE IN THE PRACTICE AND TEACHING OF FULL DENTURE CONSTRUCTION*

By W. H. WRIGHT, D.D.S., Pittsburgh, Pennsylvania

THE condyles, with their anatomic and physiologic relationship to jaw movement, have been an outstanding subject for investigation since the beginning of modern dental history. For seventy-five years, there has been a succession of discoveries pertaining to details, no single one of which was, in itself, the complete solution of this problem. The opening jaw movement, the forward movement, the variable angular divergence of horizontal and lateral condyle movements, the variable individual rotation axis, the protrusion registration, the graphic method of recording jaw movements and, quite recently, the additional factor giving consideration to the resilient and like effect, together with a satisfactory method for recording and compensating the effect, have, in succession, been called to the attention of the dentist. At present, it appears that we are in possession of sufficient fundamental knowledge to render practical an application of condylar adjustment to prosthetic dentistry. In fact, we do not hesitate to generalize this opinion as applying to all branches of restorative dentistry.

Condylar adjustment, as discussed herein, identifies that method in which the condyle path indications of an articulator are adjusted by the use of records taken from the patient's mouth, in order to produce movements equivalent to those of the jaw. This path indication is the resultant of the direction of the anatomic path over which the condyle travels, and of the deviation due to the resilient and like effect involved.

There is a noticeable tendency in the profession to forsake the high standards of handicraft of our forefathers, and to substitute sciolism. The public, however, is slowly but surely becoming familiar with the results of recent developments in the prosthetic field, and, as a result, is demanding service which many dentists are incapable of rendering. No dentist can reconcile himself to antiquated methods, when, on all sides, the gospel of progress is being proclaimed. A theoretically trained mind is a pearl of great price, but we must not forget that, in dentistry, a trained mind must be associated with skilled hands.

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

REASONS FOR CONDYLAR ADJUSTMENT

A discussion of the mechanical, anatomic, and physiologic reasons for using condylar adjustment is beyond the scope of this report. Time limits us to the following summary:

1. Clinical experience, without exception, testifies to the necessity of its universal application.

2. The condyles in the glenoid fossae remain as the only bony guide to jaw movements after the teeth are lost.

3. The condyle path which is the accepted guidance of the condyle head is peculiar to the individual, it having been established by years of function.

4. The condyle path is not changed, except in a retrograde manner, when mucosa-supported dentures are worn.

5. Adjustment of a suitable instrument permits compensation for and understanding of resiliency and like effect.

6. It furnishes a simple, practical and precise method of procedure, assuring accurate results and providing accurate means of recording conditions and comparing results.

7. The patient enjoys greater comfort, longer and more efficient service from dentures which have been constructed to conform to his individual conditions.

It becomes apparent to those who are prepared to grasp the important consideration of resilient and like effect, that it is impossible to construct accurately dentures which rest upon a mucosa base, without considering resiliency. This study further reveals that it behooves the dentist to exercise the utmost skill in each step of the procedure in order to minimize error.

The practical value of condylar adjustment becomes apparent to the dentist, only after he has, by an intelligent understanding and sufficient technical skill, qualified himself to make use of it in his daily work.

Our first experience with condylar adjustment, as advocated by Hanau, was very discouraging. It was evident that discrepancies were creeping into the work, and results were confusing. We have since found that our failures were to be attributed to misinterpretation of certain fundamentals involved and to uncontrollable factors.

Analysis of the major steps of our work convinced us that each in turn must be supplanted or altered to meet the exacting requirements of this method.

The most confusing errors were found to originate from improperly fitting denture bases, incorrectly established centric relation and unbalanced jaw relations. Improperly fitting bases were traced to faulty impressions and base plate materials.

It is advisable to discuss the requirements of the major steps on which the success or failure of condylar adjustment depends. To begin with, the dentist must realize that success with a scientific method and suitable instrument depends in a large measure on himself. The result will reflect his mental and mechanical ability.

RESIDUAL RIDGES

Residual ridges form the foundation upon which artificial dentures are constructed. They should, therefore, be discussed, by showing the relationship between ridge conditions and the effects on condylar adjustment.

Residual ridges consist of the remaining alveolar process and true osseous structure of the jaws, which is

covered with periosteum, areolar, adipose and mucous tissues. The amount of osseous supporting tissue and soft covering tissue depends on many factors, such as, time since extraction, composition of tissue, physical condition of patient, wearing of former dentures, previous loss of any combination of teeth resulting in malocclusion of natural teeth, and previous wearing of any partial or complete denture with unbalanced occlusion. These and similar conditions decidedly affect the remaining tissues. For convenience of discussion, these conditions may be listed as follows:

1. Normally resorbed osseous residual ridges uniformly covered with epithelial tissues approximately 2 mm. deep, and slightly resilient in character. This type of ridge is usually well adapted to adhesion and stability of dentures. Little trouble, if any, should be encountered in recording jaw relations and in ultimately establishing balanced occlusions.

2. Greatly resorbed osseous residual ridges uniformly covered with epithelial tissues more than 2 mm. deep, of great resiliency. Adhesion should be satisfactory, but difficulty may be encountered in maintaining stability. It is well to anticipate difficulty in registering jaw relations and in establishing balanced occlusions.

3. Residual ridges in which both former conditions may be associated. Difficulties usually arise from loss of stability and adhesion of the dentures, likewise in recording jaw relations and in establishing balanced occlusions.

4. Residual ridges uniformly covered with thin tissues possessing practically no resiliency. Jaw relations and balanced occlusion are easily obtained with this tissue condition. Difficulty may be experienced in obtaining adhesion of the dentures.

5. Residual ridges of any former type where bony areas or prominences are present. Such areas are common and must be compensated individually on the impression.

Equilibrium is that property of a denture base which resists forces tending to move or displace it. Equilibrium is proportionate to the amount of osseous foundation and the amount and distribution of resilient tissues present. Stable equilibrium is never present, owing to the fact that resilient tissues are always interposed between the denture bases and osseous ridges.

It is necessary to differentiate retention from equilibrium. Retention is that property which enables a base to stick to the mucosa owing to the saliva bond. A denture may possess retention and at the same time lack equilibrium; i. e., be too freely movable upon the osseous ridge owing to the resilient nature of the soft tissues. Retention is necessary to prevent dislodgement while a denture is not functioning. Equilibrium enhances retention, facilitates recording jaw relations and preserves balanced occlusion. It must be kept in mind that equilibrium and retention may soon be destroyed by tissue change resulting from unbalanced occlusion. Condylar adjustment demands stable denture bases.

When a denture possesses equilibrium, little difficulty should be experienced in establishing and recording balanced jaw relations. When unfavorable distribution of tissues is present, it is usually difficult to obtain correct registrations of jaw relations.

We therefore see that the condition of residual ridges has an important influence on condylar adjustment.

IMPRESSIONS

The following suggestions embody the fundamental principles for acceptable impressions, as demanded by this method.

1. (a.) An impression must cover all the maxillary or mandibular denture seating area. Accurate adaptation to the tissues must be obtained throughout this entire area. This adaptation must take into consideration the magnitude and distribution of the resilient tissue supporting areas, and the resistant areas or prominences.

2. (b.) The periphery of the impression must extend to and make contact with all fixed or movable border tissues. This peripheral adaptation must permit freedom of movement to the tissues, in order to prevent dislodgment of the dentures during rest or normal function.

3. (c.) A slightly closer adaptation of the entire periphery of an impression is obtained by using a peripheral seal. The use of this seal is advisable in order to maintain peripheral contact and, if properly applied, it will be tolerated by the tissues.

CASTS

Properly prepared artificial stone casts of impressions are demanded by this method.

BASEPLATES

In our investigation of this method, necessity furnished the opportunity of studying practically all types of baseplate construction. These were employed singly and in combination. In order to secure uniform results, we were compelled to resort to vulcanite or the ultimately used metal baseplates. Either type is especially recommended where accurate results are expected. These bases avoid many discrepancies, which usually result from warpage, or from changing a trial base to the finished denture.

FACE BOW

From the anatomic point of view, the maxillary denture area and the glenoid fossae are integral with the base of the skull. It is good practice to accept the maxillary denture area as a geometric reference basis and to mount it in the rotational relation to the condyle line in the articulator that is present in the skull of the patient. This is accomplished by using the face bow. Unless the face bow transfer is accurate within certain tolerable limits, mechanical inconveniences may be encountered. The results of such variations are especially noticeable in the condyle indications.

CENTRIC JAW RELATION

Registration of centric jaw relation is the most important technical step in denture construction. It must establish that mandibulomaxillary relation known to exist in the patient, from which, as a starting point, all major mandibular movements begin, and, at the termination of a working stroke, end. In this relation, the condyles are in their most distal unstrained functional position, and the intermaxillary space should be determined to meet the anatomic, physiologic, mechanic and esthetic requirements of the patient.

For purposes of comparison, this jaw relation may be assumed to be analogous although not identical with that found in the same patient (provided conditions were normal) when his own teeth were touching lightly in centric occlusion. In order that results may be uniform, and also for other reasons, it is recommended that no stress be applied

during this registration. In this relation, the mandibular denture base or cast is mounted on the articulator.

PROTRUDED WAX RECORDS

In order to determine the equivalent direction in which the mandible and dentures move during function, it is practicable to make a record of their position at the end of a 6 mm. protrusive jaw movement. This record is made by having the patient close into softened wax, without biting stress. This wax record is transferred with the base plates and rims to the articulator.

The instrument is adjusted until the desired seating of the rims in the wax record is obtained. The condyle indications are secured and recorded. Subsequent wax records confirm or refute the first one. Wax records made in the instrument and transferred to the patient's mouth are valuable in checking these registrations. It is interesting to note that the indication on the instrument is a path equivalent in direction to the direction of actual movement. In other words, the record made does not necessarily indicate the actual direction of the excursions of the condyle heads as they occur in the anatomy, but a direction which is the resultant of the actual direction and of the direction to be considered as the movement due to the displacement by the resilient and like effect. In addition, we adjust the lateral inclination of the condyle posts and the inclination of the incisal guidance.

SETTING THE TEETH

Artificial teeth must be arranged in the articulator to conform to the mechanical requirements of the instrument, which, in turn, are equivalent to those of the patient. The upper and lower anteriors are placed in position to fulfil the esthetic, phonetic and mechanical requirements of the patient. The posterior teeth must be set to the mechanical requirements so that, in protrusive and lateral movements, they maintain the necessary balance to prevent dislodgment of the bases. Rules for articulation of the teeth have already been given to the profession, and are beyond the scope of this paper.

SECOND SERIES OF PROTRUSIVE RECORDS

After the teeth have been articulated and examined in the patient's mouth, a second series of protruded wax records are made for the purpose of confirming or refuting the previous ones. If the former records are confirmed, the dentures are waxed, flasked in artificial stone, packed, vulcanized and finished.

REMOUNTING

With careful manipulation, it is possible to avoid the undue changes during vulcanization. Changes may occur, and we have always found it advisable to use a new centric relation record for remounting the lower after remounting the upper denture in its original position on the machine. This record is made by having the patient close in centric relation into softened wax without biting stress. This record interposed between the upper and lower finished dentures retains the lower in the proper position while it is being remounted.

SPOT GRINDING

After the dentures have been remounted on the machine and the wax record has been removed, slight cusp interference may be noticed. This may be eliminated by spot grinding, in centric relation only, with carborundum wheels. Articulating paper may be used to locate cusp interference.

THIRD SERIES OF PROTRUSIVE RECORDS

Centric occlusion having been perfected, the dentures are returned to the patient's mouth, and a third series of protrusive wax records taken, the machine being readjusted to provide for any deviation from previous adjustment due to the influence of possible changes during vulcanization.

GRINDING-IN OF TEETH

The teeth are now ground in with carborundum powder in the several masticating positions. Final adjusting of the machine and grinding allow slightly premature contact in the region of the second bicuspid and first molar teeth. This is done for the purpose of obtaining ease of function and to enhance equilibrium of the dentures.

Protruded wax records made in the articulator and transferred to the patient's mouth are used to confirm the results obtained by those made in the mouth and transferred to the machine.

After dentures have been ground-in, they should possess at least sufficient balance in the various masticatory positions to maintain equilibrium. There should be no interference of cusps and the patient should be conscious that the teeth are hitting evenly on both sides when they are brought together, without biting stress. Tests in the mouth should be made without biting stress; otherwise, the dentures are forced into the tissue and the teeth brought into occlusal contacts which may confuse the keenest observer. It is accepted as fundamental that, if occlusion is perfectly balanced when no biting stress is applied, this balance will be enhanced by the application of biting stress. This very fact has been the most misleading feature in the checking of finished dentures. It is not sufficient that occlusion be balanced under mere closing pressure, but they should be balanced during function and simultaneously secure a pressure distribution which is tolerated by the tissues.

TEACHING OF CONDYLAR ADJUSTMENT

This entire report will be seen to hinge on the fact that the jaw travels a path peculiar to the individual, and that dentures rest upon resilient tissues. These two facts have received little consideration in many dental schools. Quite recently, it has become evident that a student cannot appreciate the significance of variable jaw movements, and of soft tissues under denture bases, if he is compelled to work with metal or plaster casts which possess no resiliency, and to use mannikins in which the condyle paths are either nonadjustable or entirely lacking. In order to become familiar with such conditions, the student must actually see them. To overcome this handicap, we use rubber models, which not only provide the necessary resiliency under the denture base but also permit the student to make muscle trimmed impressions. These models are mounted on specially designed mannikins which provide adjustment of the condyle path from minus 30 to plus 70. The relation of the mandibular model may be changed to incorporate such variations in jaw relations as may be found in patients. The models include the typal ridge forms in large and small sizes and also several abnormal variations which are difficult to restore. This equipment provides each student with individual conditions which may be totally different from those of his neighbor. By observation, the student may see and understand a great variety of conditions which he may be called on to correct in practice.

The student grasps the necessity for condylar adjustment and the significance of resiliency of tissue through the use of this equipment. He is able, by observation, to understand the relationship of the teeth to the casts and the articulator setting, for every practical variation in setting up teeth is demonstrated on the mannikins.

After this experience, the student approaches the patient with the confidence that he will be able to meet the requirements of the case, which otherwise would be possible only after an extended practical experience.

Condylar adjustment as now practiced establishes a new era in denture construction. The precision demanded by this method, which lends itself to an investigation of the problems of denture construction and is heartily recommended to all who are interested in the future of prosthetic dentistry, should revolutionize many of the technical procedures now in vogue.

A METHOD OF ESTABLISHING THE CORRECT POSITION OF THE ANTERIOR TEETH IN FULL DENTURE CONSTRUCTION*

By GRAYSON W. GAVER, D.D.S., Baltimore, Maryland

IT is not my purpose to outline a new method of denture construction, but to establish, if possible, a guide in special cases in which it is desirable to restore normal alinement of the anterior teeth and the natural contour of the face.

Not infrequently, patients insist that dentures shall restore and maintain the original contour of the face. This object cannot be obtained by conjecture, based on examination and study of the edentulous mouth. A photograph of the patient taken prior to the extraction of the teeth, and full and partial facial casts also secured before removal of the teeth, are aids in approximating the position of the anterior teeth in substitute dentures, but they do not provide definite and actual measurements upon which to base the work of replacement of lost organs. In order to overcome these deficiencies, the exodontist should refer the patient to the prosthetist before extraction in order that necessary and reliable information may be collected and charted for future use and guidance in the restoration of facial normalcy. To accomplish this purpose, means must be at hand whereby the facial expression is preserved in some manner which may be relied on as both accurate and natural.

NEGATIVE PROFILE

The method conceived and applied by me in the procurement and preservation of information on the subject has been designated as the negative profile. It is intended to provide means whereby the anterior teeth, particularly in artificial dentures, may be arranged to cor-

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

respond definitely with the position occupied by the natural teeth.

In the construction of the negative profile, the patient should be seated comfortably in the chair with the head resting at an angle of about 45 degrees, the hair and clothing well protected and that portion of the face to be covered with plaster well lubricated with liquid petrolatum. A mix of slow setting plaster, about one-sixteenth inch in thickness, is then applied to the face by means of a small soft brush. This application should extend from the hair line on the forehead to a point well below the border of the chin. This plaster coating need not be more than three-fourths inch in width throughout its full extent and should be distributed directly over the median line of the face, including the forehead, nose, lips and chin. The outline of the profile will simulate to some degree the nose protector usually worn by football players. While the plaster coating is still soft, a piece of No. 9 gage soft lead wire, previously made to conform to the outline of the profile, is then embedded in the plaster as a means of reenforcement of the piece or part. After the plaster setting is under way, the lip line is opened slightly by a thin flat instrument inserted between the lips near the angle of the mouth and passed gradually under the plaster covering, to such a point that the incisal edges of the two upper central incisors rest on the instruments. In this operation, great care must be exercised in order not to distort the plaster. The next stage in the technic is the insertion of an ordinary pin through the half set plaster at a point near or against the mesio-incisal angles of the upper central incisors. The second coat of plaster is then applied over the enmeshed wire to a thickness guaranteeing handling without distortion. After this double coating of plaster has thoroughly set, it is removed from the face and all rough edges are smoothed off. The negative plaster profile thus produced affords a definite means by which the length of the anterior teeth and the fullness of the lips can be determined. This method greatly surpasses the use of the profile photograph or other known means of restoring the expression to a nicety.

As a further aid to natural restoration, the prosthetist should obtain an upper and lower impression immediately before extraction in which the extracted teeth may be placed. These impressions may be taken in modeling compound, preferably impression tray compound, with a minimum amount of drag around the teeth. After the impressions thus obtained are thoroughly chilled, the buccal and labial flanges are cut away, the impression of the occlusal and incisal edges of the teeth being left. The remaining portions of the compound impressions are then adjusted to the mouth, and the buccal and labial flanges are restored by the use of plaster, which is preferable as an impression material because it gives a more nearly normal contour of the gums in the finished models and facilitates the replacement of the extracted teeth. The natural teeth, after removal from the jaw of the patient, should be thoroughly cleansed and dried before replacement in the impression, and made secure in position in the impression by waxing on the lingual side. With the teeth in position in the impression, models are made and later mounted on an articulator, ready as a means of reference when the proper

time arrives for the construction of an artificial denture.

The models and the negative plaster profile furnish the data from which may be determined the correct position of the anterior teeth in the set up of a truly duplicate artificial denture.

After the gums have healed sufficiently, casts are made of the arches, and, upon these, bite blocks are constructed. The vertical relation of the arches can then be registered. The upper bite block having been placed in the mouth and the negative plaster profile moistened and adjusted to position on the face, it will then be possible to see whether or not the upper lip takes its original and normal position. In case the lip has not been restored to its normal fullness, the anterior surface of the bite block may be built up to meet the deficiency. Conversely, if the lip shows too much prominence, reduction of this area on the bite block may be made to the extent which the case demands. With the lip brought into proper position, the length of the bite block is made to correspond with the position of the pin previously inserted in the negative plaster profile, which established the mesio-incisal angle of the upper central incisors. This point should be retained on the bite block.

The lower bite block is then placed in the mouth, and the length of the anterior teeth and the fullness of the lower lip are determined by the method employed in the upper denture. The vertical relation of the arches is completed by establishing a work bite, clearance space and curves of occlusion.

The bite is then transferred from the mouth to the articulator, and the anterior teeth are arranged in position so that they take the general contour of the bite plates. The model holding the natural teeth will be an aid at this time in the copying of any irregularities that may have been present in the natural set.

The negative plaster profile has been designed especially for use with the Wadsworth articulator. A fundamental principle involved in this articulator is the location of the radial center from which the curves of occlusion may be established. With data at hand on the bite plate, namely the mesio-incisal angle of the upper centrals, and the position of the condyle remaining constant, two points from which the radial center can be established have been located.

It is possible to transfer that portion of the negative plaster profile which covers the lower portion of the face to the articulator by means of the face bow. This will give a clear conception of the relation of the teeth to the negative plaster profile.

It is realized that the use of the plaster profile is quite limited, but there are times when the demand comes for a definite restoration of facial contour and tooth alinement, and unless accurate means of doing so are at hand, the outcome is not always wholly successful. In all such special cases, the use of the negative plaster profile, accompanied by already outlined aids, will surely give promise of reasonable, if not complete, success.

ORGANIZATION OF AN EDUCATIONAL PROGRAM TO MEET THE DEMAND FOR ORTHODONTIC SERVICE*

By ARTHUR D. BLACK, A.M., M.D., D.D.S., Sc.D., Chicago, Illinois

I HAVE been requested to present from the point of view of an administrative officer of a dental school, suggestions as to the teaching of orthodontics to meet the public need for this service. It is presumably the duty of one who directs the educational program of a professional school to study the public need and so shape the teaching program that graduates will be qualified in the best possible way to give satisfactory service. Thus, the public need represents the demand and the school furnishes the supply.

The public need in orthodontics, as in every other type of malcondition or disease, presents two distinct problems—treatment and prevention. This paper will consider only the obligation of the dental school in teaching methods of treatment, although we must, in passing, refer in general terms to the duty of the dental college to place great emphasis on the proper care of the deciduous teeth and the first permanent molars, including training in a separate children's clinic, as an important means of preventing malocclusion of the teeth and disease of the peridental membrane, and controlling dental caries. An extended experience with carefully kept records shows the number of cases of serious malocclusion to be comparatively small if there is good care of mouths during early childhood.

Reliable statistics as to the number of persons in need of orthodontic service are not available. It is common knowledge among dentists that the number of qualified and partly qualified orthodontists is almost negligible in comparison to the need. Under present conditions, orthodontic service is available: (1) by specialists, for a very limited number of persons, the most of whom are well-to-do; (2) by a limited number of general dental practitioners, the large majority of whom know little of underlying orthodontic principles and, therefore, give questionable service; and (3) by dental college clinics, in which the variety of effort and accomplishment is such that it would be difficult to estimate its value. On the whole, we may say that the need of orthodontic service is tremendous, with no adequate plan to meet this demand. In my judgment, dentistry has kept pace less well in orthodontic service than in any other department.

This situation appears to be due to several factors: (a) lack of training of dental students; (b) lack of a sufficient number of men of broad vision who have taken up the specialty of orthodontics, and (c) failure to recognize

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the obligation of the profession to solve this problem in a practical way.

It is fundamental that the training of those who are to practice orthodontics, either as a specialty or as a part of general dental practice, should be given by our dental colleges. Our schools have not made provision for the proper teaching of orthodontics, largely because of the influence of those who are practicing this specialty, and who have taken the position that it is impossible to teach orthodontics to undergraduates, yet have offered no substitute plan.

It is equally fundamental to recognize the fact that, for many years to come, a large number of general practitioners should be qualified to give orthodontic service; otherwise, an enormous number of children will necessarily be without any orthodontic attention whatever.

There has been developed no generally accepted plan of teaching orthodontics. In several schools, the course consists entirely of lectures and demonstrations, the student having no opportunity whatever to learn from that greatest of all teachers—experience. In other schools, a large number of cases are undertaken without careful diagnosis or planning, and without an adequate staff, so that neither patients nor students receive much benefit. In most schools, the clinical training is limited to the senior year.

In operative dentistry, the student spends a year in the study of oral anatomy, followed by an extended course in oral histology, in which the structure of the teeth and the surrounding tissues are studied. A year is devoted to the technical procedures in filling teeth, prophylaxis, etc., accompanied by studies in physiology, in the forces involved in the mastication of food, the physical properties of filling materials, etc. Then, while studies in the pathology of caries and of the investing tissues are carried on, the student gains practical experience over a period of two years in the performance of operations in the clinic. Here is a related, well-coordinated plan, by which, over a period of four years, on a foundation of biology, chemistry and physics, one progresses step by step to an understanding of his problem. In prosthesis, a similar program is in operation. In oral surgery, the student is first grounded in the medical sciences, then studies the normal structure and functions, the derangements caused by violence, infection, etc., and proceeds logically with treatment.

In orthodontics, most dentists, and possibly a good many teachers, seem to see nothing but a mechanical problem of correcting irregularities of the teeth, and the teaching has consisted largely of the making of appliances and their use. The successful practice of orthodontics probably requires more intimate knowledge of biologic principles, of physical forces and physiologic function than any other branch of dental service. The course in orthodontics should be as long as the dental course; and it should be continuous throughout the entire four years. A course in oral embryology, following the course in biology, should explain the development of the mouth parts, including many items which make for normal or abnormal occlusion. The first year course in oral anatomy should be directed quite as much toward orthodontics as toward operative or prosthetic dentistry. It should include a study of normal occlusion and the part which each tooth takes in normal mastication. This course

should also include the musculature of the lower half of the face. The course in oral histology should give especial consideration to those structures which are involved in orthodontic problems, such as the absorption and rebuilding of bone, etc. There should be studies in a children's clinic of the development of the jaws and face—growth from the infant to the adult. A picture of the healthy normal should be established and maintained. There should be a technic course in which the student would learn to make appliances and study the principles involved in their use. This ground work should be completed by the end of the second year.

During the third year, orthodontic problems should be discussed. It is recommended that the principal course of lectures and demonstrations, including diagnosis and treatment, be given during this year. In the early part of the year, the clinical instruction should be given entirely by demonstration. The more simple cases should be taken first. The age limit of patients should be low, in order that they will serve best for teaching and their progress under treatment be rapid enough to enable the student to see them through.

During this year, the treatment of cases may gradually be turned over to students under careful and adequate supervision. By this, it is meant that the student should serve as an assistant to the instructor, and carry little responsibility. Ample provision should be made for the summer care of patients; in fact, this service should be made a prominent feature of the clinical service of a school during the public school vacation period.

Senior students should be given some responsibility in the handling of cases, to the end that they will, from this experience, become interested in carrying on in this work, as in the other branches of dental service.

A dental school that considers the teaching of orthodontics a real obligation for public service should supplement its undergraduate work with extended graduate courses, which might be considered as continuation courses for students who expect to specialize in this branch of service. It is strongly recommended that every specialist should have at least five years in general practice before confining his services to a specialty. A graduate course in orthodontics should occupy half time for two or three years, in preference to full time for one year or more, in order that the largest possible number and variety of cases may be observed from beginning to end. The arrangement of both the undergraduate and graduate courses should be such that each student will have time and opportunity to observe many cases besides those with which he is immediately concerned.

In the foregoing statements, it has not been my object to outline a course in orthodontics, but rather to emphasize the fact that there is no such thing in our schools today, and to point out in a general way the opportunity for cooperation and coordination of our various instructional units to contribute their respective shares to the making of a course.

It is the duty of our dental colleges to give every student as thorough training as possible in orthodontics, with the expectation that a large number will, when they graduate, be sufficiently well grounded that they may eventually give satisfactory service. We may not expect that there will be, within fifteen

of more years, a sufficient number specializing in orthodontics to care for those who might be considered regular dental patients. It seems imperative, therefore, that the dentist in general practice, located outside of the most populous centers, give whatever orthodontic service his clientele is to receive.

It has been frequently said that the general practitioner does more harm than good in his orthodontic efforts, and this is probably true. In fact, it should be expected, in view of his inadequate training in school. It is quite possible to give every dental student much more of orthodontic training during his regular college course than the large majority of those who are now specializing have had in both undergraduate and postgraduate courses. This question seems to resolve itself into one of slipping back to the plan of apprenticeship or progressing to make the teaching of orthodontics a real part of our educational program.

In the new building now being completed for Northwestern University Dental School we have made provision for the teaching of orthodontics in courses parallel with operative and prosthetic dentistry. In addition to a properly equipped technic laboratory, there are separate orthodontic clinics for undergraduates and postgraduates, each having adjoining diagnosis and record rooms, technical laboratories and demonstration amphitheater, and also ample photographic and radiographic facilities. The undergraduate clinic has thirteen dental chairs, with opportunity to use thirteen additional chairs on stated days. The postgraduate clinic has six chairs. We are gradually developing a staff that will be adequate to give didactic, technical and clinical instruction, and the service of the school to our community will be in fair proportion to our service in other clinical departments.

We must take a much broader view of the whole orthodontic problem. We need most of all to educate the oncomers in our profession in diagnosis and the basic biologic problems with which these defects and their correction are concerned. If that can be done, a large number will be sufficiently interested to learn how to treat successfully the children who come under their care.

ETHYLENE ANESTHESIA IN DENTAL AND GENERAL SURGERY*

By EDWARD L. MORAVEC, D.D.S., Cedar Rapids, Iowa

IN considering the subject of ethylene in anesthesia, in fact of any anesthetic, we should first consider the fitness of the patient, or imperiling conditions. In solving problems that arise, the anesthetist and dental operator have a few simple aids at hand: (1) history of the patient; (2) certain pathologic conditions; (3) pulse rate; (4) pulse pressure; (5) blood pressure; (6) breath-holding test; (7) hemoglobin index, and others. These things, when charted, serve to fix the attention of the anesthetist and operator as to oxygen needs, especially in hospital anesthesia.

Someone has suggested a simple test, the breath-holding test, which I use to a considerable extent in judging the patient's ability to withstand an anesthetic. To determine the conditions, we use this respiratory test, asking the patient to close the lips and compress the nares with the finger. The healthy individual will hold the breath from thirty to fifty seconds; those having weaker heart muscles, from ten to twenty seconds. This test may indicate a number of things. It may reveal an apnea due to acidosis, or it may indicate chronic disease, such as myocardial degeneration. This simple respiratory test may serve as a warning in diabetic, cardiac or renal risks. It serves principally as a warning to investigate further and, where possible, to correct some of the conditions before operation. Fever is a factor to be considered, since it has been determined by pathologists that for each degree of fever, metabolism is increased 7.2 per cent.

Even after many thousand anesthesias, we are sometimes of the opinion that great risks are the exception, even in dentistry and oral surgery. The average exodontist and anesthetist daily meet patients who are anything but safe risks under anesthesia. Fatalities still occur in chair and on operating table, even in the hands of the more skilled anesthetists; indicating that the condition of patients has become the prime factor in determining the risk involved, and also indicating the need of still greater precaution in the use of anesthetics and likewise a need for more skilled anesthetists.

Ethylene has a specific effect on the central nervous system by reason of the exclusion of oxygen. Blood dissolves more ethylene than water, apparently for the reason that it is taken up by the lipoids of the corpuscles. It is introduced by way of the respiratory tract into the lungs, distributed through the alveoli of this organ, and taken up by

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the blood serum, on which it has but little specific chemical effect, anesthesia being produced by some change in the oxygenating process of the body. Suboxygenation begins in the pulmonary circulation, where, owing to lack of oxygen, the pulmonary blood passes unchanged into the pulmonary veins, producing more or less stagnation, which results in an anoxemic condition or asphyxiation.

With ethylene, it is sometimes difficult to determine the oxygen supply as cyanosis is far less marked than in nitrous oxid anesthesia. Profound anesthesia is obtained, especially in anemic patients or those showing lowered hemoglobin, without the slightest sign of cyanosis being present, so that those of limited experience may easily be deceived in signs of anesthesia. Ethylene, like nitrous oxid, is dangerous when anoxemia without cyanosis is present, or when the brain cells partake of a general anoxemia, which prevents the recording of pain, since the brain cells, like the pulmonary veins, function only in the presence of oxygen. After asphyxia, there would be a total cessation of all life processes. We, therefore, cannot depend on automic regulators or other mechanical devices for measuring oxygen percentages, but there must be human intelligence exercised in the administering of anesthesia, with the patient's condition at all times the barometer. Enough oxygen should be used to prevent cyanosis at all times. In my work, I find no place for cyanosis. If anesthesia is not sufficiently deep without it, I prefer adding a synergist. In surgery, a prehypodermic may be given. I prefer morphin, one-sixth grain, atropin, one-one hundred-fiftieth grain, and if extreme relaxation is required, the addition, for a short period, of ether, if there is no special counterindication. With a little willingness on the part of the surgeon to work with a slight disadvantage to himself, for the comfort and welfare of the patient, the work can be accomplished without the addition of a synergist.

At a number of clinics, such as the Mayo Clinic at Rochester, a fourth gas is added, namely carbon dioxid, for its effect in stimulating respiration. The most satisfactory combination I find is, approximately, 75 per cent ethylene, and 20 per cent oxygen, with the addition of 5 per cent carbon dioxid, having the effect of smoothing out an anesthesia which otherwise was not completely satisfactory. It is true that rebreathing will develop the necessary carbon dioxid gas within the patient, and I am not entirely convinced that this is not a better method than that in which carbon dioxid is added from the tanks, since the danger in carbon dioxid is from an overdose, causing bronchial irritation, coughing, and other symptoms of carbon dioxid poisoning. In the hands of the unskilled, it is far more dangerous than the rebreathing method.

In war-time surgery, it was found that often shocked soldiers died under anesthesia, and that with nitrous oxid and oxygen, an excess of oxygen was necessary to reduce shock in the first degree. It was found that oxygen could be used, from 20 to 30 per cent. In extreme shock or circulatory depression, as high as from 40 to 60 per cent was necessary, since the lowered hemoglobin index spelled collapse unless an excess amount of oxygen was added. The same condition is often found in cases of intestinal obstruction, in nephritic cases, or in lowered resist-

ance due to disease or age. In all such cases, a high percentage of oxygen is indicated, even though with ethylene it does not appear, from the color of the skin, to be necessary. The anesthetic problem in genito-urinary surgery is one of the most difficult. So many of the patients are aged and, as a result, are more or less afflicted with changes resulting from senescence. These patients are often victims of arteriosclerosis, hypertension associated with hypertrophy of the prostate and various lesions of the heart, such as myocarditis and coronary sclerosis. The presence of these conditions and fear of postoperative complications make a non-irritating anesthetic such as ethylene desirable.

McKesson has formulated a rule for measuring the severity of shock during operation. He holds that a typical case of shock is characterized by a diastolic pressure of 80 mm. or less, a pulse pressure of 20 or less, and a pulse rate of 120 or more, and he states that "after a half hour of sustained low pressure and rapid pulse has been passed, almost every patient succumbs either shortly or within three days, of surgical shock and heart exhaustion."

A patient has a systolic pressure of 120 and a diastolic pressure of 80; the pulse pressure is 40, the ratio of pulse to diastolic is 40 to 80 or one-half, which means 50 per cent of the diastolic pressure. This pressure ratio is really an important matter and represents the relationship between the kinetic energy expanded by the cardiac contraction in moving the blood column and the potential energy stored in the arterial walls and column of blood which they contain. If the pressure ratio is high or low, there is reason to apprehend danger. If the pressure ratio lies between 25 per cent and 75 per cent, the case is probably operable. If outside of these percentages, time should be taken for further investigation and preparation of the patient for the ordeal of surgery.

Ethylene has its drawbacks even though it may be considered a more nearly ideal anesthetic than nitrous oxid. It still carries with it the explosive danger. There have been a number of accidents throughout the country from various causes or other, due to this factor, and many attempts have been made to eliminate these dangers. I believe that electrical conditions found in certain hospitals and offices may be responsible, while other places and other locations may be safer.

At the Presbyterian Hospital in Chicago, two or more minor explosions have occurred, which caused them to discontinue ethylene for a period, and go into an extensive investigation, with the assistance of the Commonwealth Edison experts, of static conditions. It was found that, by certain groundings, electrostatic sparks could be eliminated. The fact that an explosive mixture may result under certain conditions is generally accepted. The humidity is a factor to be considered. The Presbyterian Hospital has gone so far as to place ground wires in the cement floors of the operating room and by various means have made ground connections with operating table, patient, gas machine, anesthetists, and all other equipment of the operating room. Since then, no accidents have occurrred.

I believe that extreme electrostatic conditions exist in but few places. I have used ethylene in both office and hospital work from almost the beginning of its use and have never had, so far, an unpleasant experience or explosion of any kind. However, I have followed all prescribed precautions to the very letter.

I still believe that ethylene will not displace nitrous oxid as an anesthetic in either hospital or office work. I be-

lieve that, with the cooperation of the surgeon, with premedication, and in the hands of skilled anesthetists, as much can be accomplished with nitrous oxid as with ethylene. In my own practice, I am using ethylene principally as a synergist to nitrous oxid, employing it only in the most obstreperous cases, believing that, in the combination, a little more anesthesia can be assured the patient, and a little more relaxation can be secured. I find also a considerable variation in the ethylene in different tanks. A little more nausea is experienced with ethylene than with nitrous oxid. That also varies with the different tanks, owing possibly to the variation in its purity in the manufacture. The unpleasant feature, the odor, of ethylene is to be considered, but this can be overcome entirely by the use of nitrous oxid for induction and completion of the anesthesia. Ethylene is being improved in this respect as the manufacturers gain more experience.

A short time ago, a tragedy was reported from the use of ethylene contaminated with carbon monoxid gas. An effort is being made by Dr. John Lundy of the Mayo Clinic to put the manufacture of anesthetic gases, including ethylene, under federal control in order that it may be better and more uniform.

CONCLUSION

I wish to call your attention to the advantage of using ethylene in cases of chronic hypertension. This type of case leads me to believe that it is in the weak patient and the poor risk that the advantages of ethylene are most strikingly demonstrated. Ethylene is nontoxic, with but little effect on ordinary blood pressure. However, in chronic hypertension, the pressure may drop to an almost normal level without danger, provided the pulse rate decreases accordingly during operation. The ordinary cases of shock do not manifest themselves as quickly or to the same extent under ethylene as under other anesthetics. Its most striking advantage is in bad heart conditions, acidosis, nephritis, or any condition attended with debility. A preliminary hypodermic is routinely used in my hospital work, but in my exodontia or office work, only a small dose is used, and in selective cases only.

It is my belief that ethylene merely adds to our selectivity of anesthetics. In its action, it comes nearer the ether family; in other words, it takes a position midway between nitrous oxid and ether, giving us a little greater range in anesthetics. I do not believe that any one given anesthetic is indicated for every type of case. The anesthetist should have all available information concerning the patient and should be allowed to govern the selection of the anesthetic to be used, since he alone is held responsible for the welfare and life of the patient as far as the anesthetic is concerned.

THE TECHNICAL TRAINING OF THE ORTHODONTIST*

By ABRAM HOFFMAN, D.D.S., F.A.C.D., Buffalo, New York

IN preparing a paper on the technical training of the orthodontist, one's mind almost instinctively turns to the thought of mechanical procedures, for, with the use of the words "technical training," it can hardly be otherwise, as, in its accepted use, the word "technical" pertains to the development of the mechanical arts. One almost as quickly comes to the realization that he is treading upon extremely thin ice when applying the term in conjunction with the science of orthodontia, because many of the best minds delving in the science are decrying the importance which has heretofore been given to mechanics in the practice of orthodontia.

It is recognized that orthodontia owes its origin to the application of mechanical principles and that the rapid development of the art has been, in a large measure, due to refinements in appliances. It is further recognized that biologic and physiologic fundamentals have not been given the consideration which the subjects justify, but it remains a fact that, until such time as we are able to prevent the development of malocclusion and the concomitant malformations and malfunctions, we are fully justified in a continuance of intensive study and research work in the field of orthodontic mechanics and appliances.

The advocacy of a better understanding of the biologic, physiologic, etiologic, and we may well include physical, principles in orthodontia is by no means new, and the keener orthodontic minds are heartily in favor of a greater elucidation of these principles. Still, it must be plainly evident that technical training and the application of mechanical principles are absolutely necessary in the field of orthodontics as long as corrective treatment is necessary.

It has been repeatedly stated that dental educational affairs are in an unsettled state and undergoing revision; that the education of the orthodontist is urgently in need of careful consideration during this period of reconstruction, for not only is the condition unsettled, but there seems also to be a very definite division of opinion on the subject. Apparently, because of this difference of opinion, it remains for some authoritative body to assume the rôle of dictator and say what shall be taught (and when), for among us are many brilliant minds who believe that

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the undergraduate should be taught only the fundamentals of orthodontics, to the exclusion of technical and clinical training, and on the other side is the group confirmed in the belief that the obligation of the dental school is to prepare the young dentist to render a reasonably efficient service in all branches of dental practice.

The dental educator should not be condemned if he takes the latter view, but rather should be commended, if the effort is earnest and sincere. As long as we are compelled to do restorative or corrective operations on the teeth, applied mechanics is not only increasingly important, but absolutely indispensable. When we reach the point where *prevention* predominates, then and then only can we forego "technical training."

If the practice of orthodontia occupies the important position in health service which we are willing to admit it does, and if the results of treatment have such an important bearing on health, appearance and well-being as we admit they have, and if the demand for this type of service exceeds the supply of trained operators, which it does, then it becomes the duty of the various institutions concerned with higher education to provide adequate facilities, in every way, for the teaching of the art. This necessitates a decided departure from the time honored method and sequence in the courses of study for the undergraduate student. It implies a competent corps of instructors in the department of orthodontics, a large well-managed and well-equipped clinic operating throughout the year for the benefit of both student and patient, adequate laboratories, technical apparatus, and facilities for technical teaching, the opportunity for, and carrying on of, research work, etc. There is no just reason why this department, wherein the prime aim is to teach or establish occlusion (which is recognized as the basis of all dentistry) should not have the same or better advantages than are offered in the other departments for training in health service. The manner in which this subject has been, and still is, taught and looked on in most dental schools is deplorable.

It is not my intention to advocate the making of orthodontic specialists in the undergraduate school, but rather to encourage a more thorough course in the fundamentals, technical procedures and clinical practice, just as in operative dentistry or prosthesis, in order to supply the student with a foundation upon which to build, should a practice in orthodontia appeal to him later in life. If his later trend should not lead to orthodontia, he will have been so trained as to be better able to recognize his limitations and thus render a greater service to the public because of a more ample knowledge of the subject.

I have been in more or less close contact with the dental educators of America for the past twenty years, and have heard the question of curriculum content discussed by school administrators *ad infinitum*. I have also been for a like period a more or less regular attendant at the sessions of the leading orthodontic societies and there too have heard the question of orthodontic education discussed by those who have de-

voted many years to the study and development of the specialty. The conclusion has been that those who should have been most vitally interested do not seem to be able to see "eye to eye," and the inevitable result has been that the dental student, the dentist and the public are the losers.

There is one point at least of common ground, and that is that the student should be taught the theory of the science, a phase of the subject which will be included in another paper of this group. The real bone of contention seems to lie in whether or not the student should be instructed in the technical and clinical procedures.

Assuming that the school administrators were the proper ones to determine what should be included in the orthodontic curriculum, a series of questions was sent to the deans of forty-two dental schools of America, and forty replied. These replies are the basis upon which the advocacy of "technical training" is advanced, and they afford the opportunity for the suggestions herein offered.

The first question submitted to the deans was, "Should the subject of orthodontics be included in the undergraduate curriculum?" The answer to the question was so definitely and so positively in the affirmative as to leave no doubt that the subject should be taught. All replies were in favor of including the subject. As the words "subject of orthodontics" were rather broad in scope and might have been misunderstood, there followed several related questions, the next being, "Should such instruction be didactic only?" Here two of the answers were "No" and one favored making it a graduate course; indicating that thirty-seven out of forty educators believe their students should receive something more than theory only.

Then followed "Should such instruction include a reasonably complete course in laboratory technic?" Here thirty-four were definitely "Yes," one answer indicated "Yes," two were negative, two were in doubt and one failed to answer. The replies indicate that a laboratory technic course is essential.

The next question, or really two questions in one, presents the real stumbling block in the undergraduate course and is a problem which must be decided before long. The question was: "Should the instruction include clinical practice by the student, or should such clinical instruction be given *only* through demonstrations by the teacher?" Here twenty-six of the replies favored student practice, three were in doubt but inclined toward it, six favored demonstrations only by the teacher, and five were in doubt but favored the latter. Again the majority favors the student.

Thinking that there might be some question as to the correctness of classing "clinical practice" under the head of "technical training," the further question "Do you consider 'technical training' to include clinical practice?" was submitted and six replies were in the negative, two were doubtful and four failed to answer. Therefore, twenty-eight were in the affirmative and the conclusion is that the student should have the opportunity to develop operative skill.

A review of a report of the British Society for the Study of Orthodontics published in the *International Journal of Orthodontia*, March, 1926, places that organization squarely in favor of a liberal training in orthodontia for the undergraduate.

The replies to the questionnaire were for the most part from the deans of the schools. In those cases in which the teacher answered, the response was accompanied by a letter from the executive, indicating his approval of the answers; hence, it is interesting to note that, to summarize, the dental deans believe the subject of orthodontics should be taught, not only in the fundamentals and theory, but in the form of laboratory exercises and clinical practice as well. Time does not permit the inclusion of some of the very definite and emphatic responses, which will be found in the appendix herewith, but it is sufficient to say that, from their point of view, orthodontics requires no more serious nor vital consideration than many of the other present-day problems in dentistry and dental teaching. It must be said in justice to all that, in many instances, these educators express the belief that, for specialization, one should pursue at least a full academic year's work in the graduate school.

I believe that, for the best interest of our profession, this science and the public, orthodontia should be practiced as a specialty, but every dental student ought to have a relatively complete schooling in orthodontic science. There should be included in every undergraduate curriculum, in addition to the theory, at least a reasonable amount of instruction in laboratory training and clinical practice, with the supervision, advantages and opportunities previously referred to. Without question, the manipulative skill developed in this line of endeavor is of untold value in the other branches of dental training, for many of the procedures are not found elsewhere.

I further believe that the man who, in the future, elects specialization in any of the healing arts must be properly qualified, and that the best way to become properly qualified is by way of special training of at least one academic year in the graduate school of the university, and that the satisfactory appraisement of his effort should be in the form of a "degree" granted by the university.

I am heartily in favor of introducing a course in dental technology early in the dental curriculum, and I believe that such instruction would conserve much of the students' time, as well as duplication of effort by the teachers. The fundamentals of all the dento-mechanical procedures might well be given in one laboratory, with one capable instructor as the head of the department—an intensive course that would give the student to understand that the carving of an ivory tooth or the study of form will have a direct application in prosthesis or orthodontia as well as in the next usual technic steps of cavity formation and fillings; that the mechanics of mastication gleaned from the use of an articulating frame is just as important in the performance of operative dentistry (as usually understood) or orthodontia, as it is in prosthesis; that the physical properties and the manipu-

lation of metals in soldering or casting is the same whether used in operative dentistry, prosthesis or orthodontia; that a study of arch formation and occlusion applies with equal stress on all branches of dentistry. The foregoing is sufficient to convey my idea. Let the application of these principles, with the necessary modifications, follow more specifically in a short intensive laboratory course in the several departments as the different subjects are taken up. This will necessitate a correlation of teaching ideas, but why should there not be a correlation? The day of "individualistic" teaching is, or should be, passing.

I believe that the best time for giving the specialized technic course in orthodontics is in the junior year and the laboratory work should be accompanied by lectures and demonstrations having a direct application. During this year, the technical phases of practice should be presented in the form of demonstrations by the teacher, gradually introducing the student into practice by his assisting in the demonstration.

A dental course which has been carefully planned and in which the correlation of the basic sciences and orthodontic principles has been stressed should equip the student so that, by the senior year, he will be ready to assume some responsibility in the handling of selected clinic cases, under the immediate guidance of capable demonstrators. The amount of work thus undertaken by the student should be of sufficient quantity and variation to make his effort and the teaching effort worth while.

The following suggestion may carry a thought, capable of elaboration, in conduct of an orthodontic clinic. The case, after being accepted as suitable, is assigned to a demonstrator for treatment, and he will be absolutely and wholly responsible to the head of the department for the progress, etc., during the treatment. The demonstrator, in turn, will assign a student to assist with the case, and, as the student develops the proficiency and necessary skill, he will be allowed to carry out more and more of the treatment, the demonstrator retaining responsibility for the case. During the year, the student should be rated on his progress and proficiency just as in other departments of clinical practice. Such a plan offers many advantages and these should be apparent to the thoughtful person. A further suggestion is (and the teaching value should be obvious) that all "first" appliances be made by an experienced technician, the student being required to make duplicate parts and minor attachments as required.

I would recommend that these conditions, in a general way, be applied to the technical clinical training in the graduate school. Here, of course, a more rapid advance by the student may be expected, and a corresponding letting down of the bars could be granted.

In closing, I shall paraphrase a statement by Dr. Frank W. Chandler.[1]

> What we need in the field of orthodontia is a greater appreciation of a common problem, an appreciation of our obligation to the profession and to the public; to recognize the truths that are apparent; to be governed by the welfare of the public rather than by our own motives. When the last word has been said, whether individually or collectively, if we have increased happiness and comfort and function in the effort to cope with the problem, in all ways we shall have been successes and made our lives worthy of our living.

1. Chandler, F. W.: Oral Foci and Their Eradication, Oral Hygiene, February, 1926.

Orthodontic Questionnaire*

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical practice by the student?	Should such clinical instruction be given only as demonstrations by the teacher?	Should orthodontics be taught only as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
University of Buffalo, School of Dentistry	A. Yes.	A. No.	A. Yes.	B. Clinical instruction given as demonstration by the teacher.		No.	(a) Yes. (b) No. (c) Yes.
University of Illinois, College of Dentistry	A. Yes.	A. No. Should include certain laboratory instruction as illustrated in the syllabus attached hereto.	A. For example, see Number 2.	D. Would recommend demonstrations to groups in the form of case studies, or placing the subject as an elective.		The amount of orthodontia indicated above should be in the undergraduate curriculum, but preparation for the practice of orthodontia as a specialty should be predicated upon a graduate course leading to a master's degree.	Yes.
Vanderbilt University School of Dentistry	A. Yes, orthodontics should be included in the undergraduate curriculum. The fundamental principles should certainly be taught.	B. Yes.	C. There is a serious question in my mind as to the laboratory technic being taught in an undergraduate school, owing to the fact that a great many students think this is about all there is to orthodontia and attempt to practice this work when they graduate, and we know that they are incapable of doing same.	A. Absolutely no.	I do not think clinical instruction should be given the student, but if so it should be taught by the teacher demonstrating with not more than four or five cases.	I believe that orthodontics should be taught only as a postgraduate subject leading to a degree in a graduate school. This postgraduate course should consist of a school term of nine months.	(a) Yes. (b) No. (c) Yes.
Tufts College Dental School	A. The fundamentals of orthodontia should be taught to undergraduates because they deal with the facts and factors conditioning developments and form of the dental arch. Such knowledge is essential in the study of dentistry.	A. No.	A. Not a complete course. Much can be taught in some of the other technic courses. Impression taking, molar band construction, simple labial and lingual base wire technic, should be about the limit. This is sufficient to base further study upon.	D. The ordinary way of "learning to do a thing" is first to have it described, then demonstrated, before attempting to do the thing. This order should be preserved in the study of orthodontics.		In a sense, every dental operation is an orthodontic operation. Thus, orthodontics assumes an essential part in a dental course. If orthodontics merely refers to art of correcting maxillary deformities, it had better be taught as a graduate subject.	

*The replies from forty out of forty-two dental schools of the United States and Canada, and a summary of the review of a report by the British Society for the Study of Orthodontics as printed in the *International Journal of Orthodontia*, March, 1926. (Compiled by Abram Hoffman.)

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical or practice by the student?	Should such clinical instruction be given **only** as demonstrations by the teacher?	Should orthodontics be taught **only** as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
College of Physicians and Surgeons of San Francisco, a School of Dentistry	A. Yes, unless provision is made in the same school for graduate instruction. In this event, orthodontics belongs largely in the graduate school, leading to a master's degree; based upon a preliminary undergraduate training of didactic instruction.	A. I think instruction should be both clinical and didactic in order that the student shall have the opportunity of coordinated work in the undergraduate curriculum. Didactic only in those schools where opportunity is afforded to do graduate work, with the clinical work in the graduate year.	A. It so seems to me. This course in laboratory technic should underlie the clinical instruction.	A. Yes, under direct supervision of the instructors.	I fail to see how demonstrations without opportunity to do clinical work by the student in orthodontia would avail him any more than were we to teach prosthetic dentistry, crown and bridgework, etc., by demonstration method entirely without the student being allowed to develop finger dexterity.	This form of instruction merits closer attention to details, and in the future dental curriculum, undoubtedly this will be the proper place for the teaching of orthodontia. Until this comes to be the generally accepted method for orthodontic instruction, we will be likely to find a diversity of opinions on this subject.	Yes.
University of Minnesota College of Dentistry	A. Briefly considered.	A. Not necessarily.	D. ?	C. May be limited to A or 3 grade student.		See letter herewith.	
Dalhousie University Faculty of Dentistry	A. Yes, if only because it gives a better opportunity than any other dental subject for correlation of fundamental scientific subjects which, if not so correlated, tend to appear to the student to have been more or less a waste of time.	A. If didactic in this connection means lecture course, I would say this should be supplemented by laboratory technic and the consideration of cases presented by the instructor.	A. Yes.	D. As Sir Roger de Coverly said "There is much to be said on both sides." During sixteen years as a teacher of orthodontia, I have conducted the work as under A; then B; then A, and now B. I still preserve an open mind on this question, but feel that clinical instruction given only by the teacher is, on the whole, more satisfactory.		I do not see that another degree is essential any more than it is necessary for the medical specialist to have an extra degree. This question can only be answered as it is considered together with the whole problem of the undergraduate curriculum. As at present, constituted, where can we find time in the undergraduate course for sufficient instruction in orthodontia to make a competent orthodontist?	Surely this is a matter of terminology. I would say that (a) and (b) are technical training, but I would not be inclined to class (c) as technical training.
University of Michigan, College of Dental Surgery	A. Yes, for the purpose of teaching students how to recognize cases that should have treatment but not necessarily for the purpose of teaching them how to practice orthodontics.	A. No, clinical cases illustrating conditions to be met in practice, of a limited number should be available.	B. No. Such work should be a part of a special course.	B. Yes.		It should be taught as a postgraduate subject without any reference to a degree. If the intellectual attainments of the student seem to justify a degree incidental to the graduate work, it would be nice to confer it.	I do not seem to be able properly to comprehend this question. Technical education either in dentistry or in other fields would include all three of the questions you have submitted.

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical practice by the student?	Should such clinical instruction be given only as demonstrations by the teacher?	Should orthodontics be taught only as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
University of Nebraska, College of Dentistry	A. Most decidedly. I am not ready to say just how much. Even if the work is to be done by specialists only, enough should be given the general practitioner to enable him to recognize and refer.	A. Depends on whether specialists only shall do the work in the future.	A. Yes, if the general practitioner is to do the work.	Same as III.	Depends upon what the future of orthodontia is to be.	We are studying this question, but we are not ready to formulate our answer as yet.	Yes.
Northwestern University Dental School	A. Yes.	A. No. Should be along the same lines as for operative and prosthetic dentistry.	D.	A. Yes, with the instructor carrying more responsibility than is the case with fillings, operations or prosthetic procedures.		No, because every dentist should know as much as possible regarding orthodontia.	Yes.
University of Pittsburgh, School of Dentistry	A. Yes.	A. No.	A. Yes.	B. Students should be assigned orthodontic patients that they may study the history of the case and be prepared to recognize these cases when they are presented in private practice. The student presents the patient to the instructor, who does the actual work in the mouth, using the patient for a clinic to a group of students. Prophylactic work is the only work done by the student.		Orthodontia should be taught in all schools that the student may be able to recognize the value of orthodontic treatment, and not with the intention of making orthodontists of each student. For those who wish to specialize, a postgraduate course of at least one year of concentrated study and practice in a recognized school is recommended.	Yes.
Western Reserve University, School of Dentistry	A. Yes.	A. No.	A. Yes.	B.	Yes.	No.	Yes.
Temple University, School of Dentistry	A. Only the fundamental.	C. Chiefly so.	A. A very liberal amount.	A. No.	Yes.	Yes.	Yes.
Ohio College of Dental Surgery, Dental Department of the University of Cincinnati	A. Yes. Has always been so with us.	A. Lecture demonstration and five cases for each student, students working in pairs and singly.	A. Yes.	A. Case in charge of student and appliances and adjustments by him.		No.	Yes.
School of Dental and Oral Surgery of Columbia University	A. Yes.	A. No.	A. Yes.	A. No.	Yes.	In preparation for exclusive specialization—yes.	(a) Yes. (b) No. (c) Yes.
State University of Iowa College of Dentistry	A. Yes.	A. No.	A. Yes.	A. Yes.	No.	No.	Yes.

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical practice by the student?	Should such clinical instruction be given only as demonstrations by the teacher?	Should orthodontics be taught only as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
Atlanta-Southern Dental College	A. Yes.	A. No.	A. Yes.	A. Yes, but only under the immediate supervision of a trained instructor.		No.	Yes.
Marquette University, School of Dentistry	A. Yes.	B. Yes.	A. Limited to technic instruction in band making.	D. In graduate school clinic only.	No.	Undergraduate didactic, graduate school clinical and theoretical.	Yes, in graduate school.
School of Dentistry, Medical College of Virginia	A. Yes.	A. No.	B. No.	B.	As demonstrations by the teacher.	I believe that either graduate or postgraduate instruction is necessary today properly to equip the dentist who wishes to practice orthodontia. The undergraduate should have sufficient knowledge of the subject to enable him to recognize early departures from the normal and to know where to refer his patients for proper treatment. He should also know enough about the appliances used to be able to carry out for his patients instructions that have been given by the orthodontist in such cases when the patient is too far removed from the orthodontist to return frequently for treatment.	I should think a, b, and c are all necessary to round out a thorough technical training.
University of Montreal, Faculty of Dentistry	A. Yes.	A. No, clinical demonstrations also.	A. Yes.	A. Both.		No, but if one wishes to specialize, he should take a postgraduate course.	(a) Yes. (b) Occasionally. (c) Yes.
North Pacific College of Oregon, School of Dentistry	A. Yes, it should be regarded as a necessary part.	A. No, it should be both didactic and clinical.	A. It should.	A. First demonstrations by the teacher, followed by clinical practice by the student.		Orthodontia should be included in every dental curriculum leading to a dental degree. To become a specialist, the student should take a special postgraduate course of one full session, which may fittingly lead to a master's degree.	Yes.

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical or practice by the student?	Should such clinical instruction be given **only** as demonstrations by the teacher?	Should orthodontics be taught **only** as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania	A. Yes.	A. Lectures, quizzes and demonstrations.	A. Yes, in sophomore year.	B.	Demonstrations by qualified men.	No.	
Indiana University, School of Dentistry	A. Yes.	A. No.	A. Yes.	A.	Directly supervised by a competent teacher.		Yes, all three.
Creighton University, College of Dentistry	A. Yes.	A. No.	A. Yes.	A. Yes.		No.	Yes.
University of Toronto, Dental Department	A. Yes.	A. No.	A. Yes.	A. Yes, both as demonstrations and clinical practice.		No.	(a)—Yes, laboratory technic in orthodontia, including impressions in all thirty-six hours.
Howard University, College of Dentistry	A. This subject is taught to junior and senior dental students.	A. Junior year, didactic; senior year, laboratory work.	A. It should.	A. We endeavor to do both when practicable.		No. If one desires to specialize in orthodontia, a postgraduate course is necessary.	Yes.
University of Southern California, College of Dentistry	A. Yes, to a limited extent.	A. No.	A. Yes.	A. No.	Yes.	It is much better this way. We expect to form such a course.	(a) Yes. (b) No. (c) Is in **addition** to forty-eight hours of actual technic training.
Baylor University, College of Dentistry	A. Yes.	A. No.	A. Yes.	A. Yes, carefully supervised. As nearly satisfactory service may be rendered the patient in orthodontia as in many other classes of dental service.	No, that form of instruction is ineffective.	No. In that case, the student never has proper opportunity to realize the possibilities and need of this type of service.	All three for most satisfactory results.
Kansas City-Western Dental College	A. Yes.	A. No.	A. Yes.	C. Clinical instruction should be given as demonstrations by the teacher except in a few instances when students are especially interested in the subject, and until courses in dentistry are revamped.		No. More stress should be laid on the subject, and the undergraduate should be required to know something about it.	(a) Yes. (b) No.
University of Maryland, School of Dentistry and the Baltimore College of Dental Surgery	A. Yes, particularly diagnosis, classification, etiology.	A. No, should include practical demonstration of theoretical teaching.	E. Not essential in undergraduate teachings, but all students should be capable of free-hand soldering and have a knowledge of materials used in the construction of appliances; a study of tooth forms and the carving of teeth.	B. No.	Only by the teacher.	A postgraduate course, including subjects and clinical demonstrations over a sufficient period of time thoroughly to ground a man in the fundamentals of orthodontics. This to follow a thorough course of undergraduate study in diagnosis in classification and etiology. A special degree has no particular advantage.	(c) Yes. "Yes" means in reference to "technical training" of postgraduate students and not undergraduates. In case you are referring to "technical training" of the undergraduates, I would answer that (b) clinical practice should not be indulged in by undergraduates. This is postgraduate training.

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical or practice by the student?	Should such clinical instruction be given **only** as demonstrations by the teacher?	Should orthodontics be taught **only** as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
University of Louisville, School of Dentistry	A. Not for the purpose of training students to become orthodontists, but for diagnostic training alone.	A. Should combine didactic and laboratory courses. Do not see how it can be learned by student as taught by instructor when it is wholly didactic.	A. By all means, in order that the student may learn orthodontic principles.	A. Yes: supervised	No.	Leading toward specialization, yes!	(a) Yes. (b) No. (c) No.
Chicago Coll. of Dent. Surg., Loyola Univ.	A. Yes.	A. No.	A. Yes.	A. Yes.	No.	No.	
St. Louis University, School of Dentistry	A. Yes. Junior and Senior years.	A. No. Didactic: juniors, first semester; seniors, second semester. Juniors, laboratory technic instruction; juniors and seniors, clinical practice by students with clinical demonstrations by teachers.	A. Yes.	A. Clinical practice by students and clinical instruction by teachers.		No. Students should have a balanced course in fundamentals of orthodontics in his regular dental course.	Yes.
College of Dentistry, University of California	A. Yes.	A. No.	A. Sufficient to point out the different physical forces applied and mechanical procedures used but not what I would call complete.	D. Students should not be given cases but might, on proving up through assistance during the senior year, relieve the instructor under supervision occasionally.		No.	(a) Yes. (b) Not wholly so. (c) Not wholly so.
Washington University, School of Dentistry	A. Yes.	A. No.	A. The technic course should include impressions, casts, solder exercises, simple bands, with simple attachments, and the construction of a simple treatment appliance.	A. Yes, they should be permitted to treat simple cases only.	This should be given in conjunction with the foregoing.	Sufficient undergraduate instruction should be given to give the student an idea of what it all means. Then, if it appeals to him, he should be encouraged to take a graduate course of at least one year or preferably two half years, for which a degree should be granted on presentation of an acceptable thesis on a research problem.	Yes.

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Harvard University Dental School	A. Yes.	A. No.	A. See following.	A. I believe that the best plan is with a course in laboratory technic followed by clinical practice by the student in his senior year.	No.	Yes.
Ohio State University, College of Dentistry	A. Yes. In my mind, a general practitioner should know etiology and diagnosis as well or better than an orthodontist because he is the one in three-fourths of the cases that the parent first consults as to the possibilities of irregularity.	A. No. A knowledge of the manipulation of appliances for the simpler cases is a good thing. Not all communities have an orthodontist available. A general practitioner is only as valuable in his community as his ability to do well a varied number of things.	A. Yes. Three or four appliances may be constructed by the student with special emphasis on free-hand soldering. There is no place in the dental curriculum where free-hand soldering may be taught so well as in orthodontia laboratory technic.	C. Here seems to be the stumbling block in undergraduate instruction. It seems to me that orthodontia is to dentistry much as surgery is to medicine and should be taught much the same. A student will get much more valuable instruction if he is allowed to assist. He may give the prophylaxis and remove the appliance for cleaning if necessary, but should be allowed to do actual adjusting only as he has proved his ability to do so by qualifying in the elementary things first. Many students become quite familiar with the type of appliance and the adjustment of it by the end of their senior year and could do nicely on a similar case. Some students will never make orthodontists and should be told so in order that they will not do their patients or themselves an injustice.	No. Postgraduate orthodontia is absolutely necessary, however, for the orthodontic specialist. In the time allotted for the teaching of orthodontics, only the fundamentals of etiology and diagnosis can be taught. His knowledge of appliances is limited to the one or possibly two cases, he has assisted in during the senior year. The student needs elementary principles of orthodontics. Biologic orthodontia is biologic dentistry, and the same principles of histology, physiology, pathology, etc., apply to both, and as soon as the student realizes and appreciates this fact, the sooner he will become interested in orthodontics and the broader will be his dental education. The laity needs an education in orthodontia. The dentist is the logical teacher and he must be able to give correct and intelligent information to his clientele.	Yes.

School	Should the subject of orthodontics be included in the undergraduate curriculum?	Should such instruction be didactic only?	Should such instruction include a reasonably complete course in laboratory technic?	Should such instruction include clinical or practice by the student? Should such clinical instruction be given **only** as demonstrations by the teacher?	Should orthodontics be taught **only** as a postgraduate subject, leading to a degree, in the graduate school?	Does "technical training" include: (a) laboratory technical exercises? (b) clinical practice? (c) clinical demonstrations?
McGill University, Dental Department	A. Most assuredly	A. Decidedly not.	A. Certainly.	A. Practice by student, amplified by demonstrator.	I do not think so. Orthodontia is defined as a branch. No hard and fast lines can be drawn between the subject and the teaching of the subject.	Yes.
New York University, College of Dentistry	Yes	No	Yes	A. Yes. B. Demonstrators should be responsible, to head of the department, for every case. Students be required to assist and otherwise become familiar with the principles of practice.	Not exclusively for every dentist should have a practical knowledge of orthodontia. A full year of graduate training should be essential for specialization.	(a) Yes. (b) Yes. (c) Yes.
Loyola University (New Orleans)	Yes	No	Yes	A. Yes. B. Student should do some practical work.	Favors postgraduate course for those who want to specialize.	Yes Yes Yes
Summary	Forty-two questionnaires were sent out and forty replies received. Forty schools favor a course in orthodontics; 37 out of 40 favor giving more than theory only; 2 were not in favor of it; one favors making it a graduate course only.		Thirty-four schools definitely favor a laboratory course; 2 do not; 3 were in doubt; 1 did not answer.	A. 26 schools favor student clinical practice. C. 3 schools are in doubt but favor student clinical practice. B. 6 do not favor student clinical practice. D. 5 are doubtful and inclined not to favor clinical practice.	A. 36 say laboratory exercises are technical training. 4 do not answer. B. 26 say clinical practice is technical training. 6 say clinical practice is not technical training. 1 says it is occasionally technical training. 1 says it is not wholly technical training. 4 questions not answered. C. 33 say demonstrations are technical training. 2 say demonstrations are not technical training. 1 says demonstrations are occasionally technical training. 4 unanswered.	

THE PRESENT STATE OF DENTAL LEGISLATION IN JAPAN*

By MORINOSUKE CHIWAKI, LL.D., Tokyo, Japan

DENTAL legislation in Japan gained a firm ground for the first time by the proclamation of a dental law, together with the medical law, but independently, May 1, 1906, and its enforcement on and after October 1, of the same year.

By the enactment of this law, the qualification and education of the ethical dentist, and the standard of dental examination, as well as the foundation of the dental profession and dental association, were established. Since then, twenty years have passed. The number of registered dentists was then about 900. Now it aggregates more than 12,000. There was only one dental school. At present, there are ten schools in all. In the course of these years, the dental law has been revised three times.

The first revision was made in 1909, when a slight amendment was made by the proposal of the government in order that the law might correspond with other laws.

The second revision was made in 1916, when new provisions were added, with the purpose of clarifying the relation between the medical and dental professions.

For the third time, in the year 1925, a considerable revision was made of almost all parts of the law.

Thanks to the strenuous efforts of the Dental Federation of Japan, the enactment of the law, as well as its revisions, has been made solely on the initiation of the Federation, which acted in accordance with the expressed wishes of the dentists and proposed the bill before the House through the members of the House of Representatives, as the government takes no interest in the matter.

In making the last revision, the Dental Federation wisely established an investigating committee for the revision, and this committee continued the work until the spring of 1924, not laying it aside even in the calamity of 1923, when a bill was drafted after discussion of the general meeting of the Federation then held. This bill was submitted to the Diet in February, 1925, and was passed by both Houses, March 20, 1925. It had been promulgated on April 13, but owing to the delay in drafting its subordinate regulations, it took effect on and after March 20, 1926.

The original purpose of this revision may be summed up as follows: (1) to elevate the standard of dental education

*Read before the Section on Dental Education at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

so that the requirement for dentists may be equivalent to that of physicians; (2) to consolidate the foundation of the dental associations and to make their administration more firm; (3) to support the development of the dental profession by providing for new regulations on the matters concerned.

As a result of discussions in the Diet, these purposes have been partly carried out. Nevertheless, by this revision, dental legislation in Japan has been greatly promoted and has assumed a new aspect.

QUALIFICATIONS AND REGISTRATION OF THE DENTIST

The revised dental law consists of thirteen articles. In the beginning, it provides the qualifications of a candidate to become a dentist as follows: (The underlined sentence or clause indicates the revised or new provision)

Article I. Any person who wishes to become a dentist is required to have any one of the following qualifications, and to obtain a license from the Minister for Home Affairs:

1. He must have graduated from a dental college designated by the Minister of Education.

2. He must have passed the dental examination.

3. He must not only have graduated from a foreign dental school or have obtained a license for dental practice in a foreign country, but his qualifications must be recognized as equal to what is required by orders.

Article II. Any person coming under any of the following clauses is not allowed to obtain a license:

1. *If he has been sentenced for a penalty of more than six year penal servitude or imprisonment.*

2. If he has not attained the proper age, or has been adjudged incompetent or quasi-incompetent, or is deaf, dumb or blind.

Article III. A license may not be granted to a person who has been either *punished with six year's imprisonment or penal servitude and upwards*, or fined in connection with medical affairs.

It provides, regarding registration:

Article IV. The Dentists' Register shall be kept at the Department for Home Affairs, and particulars relating to dental licenses shall be therein registered. Particulars of registration shall be determined by order.

LICENSES FOR FOREIGN DENTISTS

Any foreigner who had obtained a diploma from a foreign dental school, or a license for dental practice in a foreign country, and was recognized by the Minister of Home Affairs as properly qualified, formerly was entitled to a license for dental practice in Japan, without examination. But this provision has been amended by an imperial ordinance, which took effect on and after March 20, 1926, to the effect that only those foreign subjects who have dental licenses from countries which grant a dental license for Japanese dentists without examination are now reciprocally permitted to open dental practice in Japan, provided the Minister for Home Affairs recognizes such applicant as eligible. At the same time, it is announced that the British and Mexican subjects are now in conformity with the new provision for granting dental licenses.

At present, there are two foreign dentists in practice in Japan, they having been granted licenses by the authorities. Both are Americans.

THE OPENING AND MANAGEMENT OF A DENTAL OFFICE AND LABORATORY

In Japan, although no person other than a physician or dentist is allowed to give medical or dental treatment, according to the interpretation of the law by the administrative authorities, any person is entitled to open and manage a physician's or a dentist's office. In recent years, therefore, many dental offices under the management of money-making joint stock companies or partnerships have appeared. As these offices do not comply with the regulations of the dentists' association and do harm to the profession, the Dental Federation of Japan has advocated laying down certain regulations that dental offices can be opened and managed only by dentists or those who have the public welfare at heart.

In connection with this matter, the dental laboratory was, for a long time, a subject of discussion for the profession. The Dental Federation of Japan, considering the mechanical work on a model by a dental laboratory as an extension of dental treatment and fearing that such laboratories may increase rapidly, although there are only a few at present, has also advocated laying down certain regulations providing that the opening and managing shall be entrusted to a dentist and be administered by the dental association.

The above mentioned matters caused endless discussion in the Diet, but the following article was at last formulated and passed. The regulation annexed to the article is not yet enacted in spite of the repeated endeavors of the Dental Federation.

Article IV. 2. *The regulations relating to the opening or management of a dental office or dental laboratory by a person or persons other than a dentist shall be provided for by order.*

THE DUTIES OF A DENTIST

Regarding dental treatment, the law provides:

Article V. No dentist is allowed to issue a medical certificate, write a prescription or treat a patient, unless he personally examines the patient.

Article VI. The dentist *or the head of the dental office* shall keep a record book, and it shall be preserved for ten years.

Regarding the professional announcement, the law makes the following provision: In view of the evil effect arising from exaggerated advertisements, the law restricts dentists' announcements, and this restriction is also made in the medical law. That it is now permitted, by the revision, to announce the name of the specialty practiced may be regarded as progress.

Article VII.* In no way is a dentist allowed to advertise his art or treatment, or refer to his qualifications except his degree or title *and his specialty.*

THE DRAWING UP OF A CERTIFICATE OF DEATH BY A DENTIST

There has been a long continued discussion as to whether or not a dentist is competent to issue a certificate of death if a patient succumbs during dental treatment. But the government admitted such rights of the dentist prior to the promulgation of the dental law, and as it recognizes that the term "medical certificate" referred to in Article V involves a certificate of death,

dentists have issued such certificates whenever the case warranted.

When the revision was made, a discussion was raised over this matter, but replying to a question by a member in the Diet, the official of the government stated that it admits such rights of the dentist.

THE DENTAL ASSOCIATION

Regarding the dental association, the old dental law provided for:

Article VIII. Dentists may establish a dental association. Regulations for the dental association shall be determined by the Minister for Home Affairs.

According to this provision, 143 associations (forty-one prefectural and 102 county and city) have been so far established. These associations may be dissolved voluntarily and lack full function. In consequence, their combined body, the Dental Federation of Japan, is a private organization, not in conformity with the law. Hence, the necessity of enactment of new regulations.

The revised law and the dental association order, a newly enacted imperial ordinance, provide for a system of dental associations as follows:

(a) Prefectural Dental Association. The present law provides for the compulsory formation of the dental association in every prefecture, and that all the dentists in practice in the locality, except those who are serving in dental practice in the governmental hospital, shall join the association and not be allowed to withdraw from it. These associations are given the capacity of a public judicial officer, and the main object is to improve dental sanitary affairs of the country, to uphold the rights of dentists and to improve the condition of the profession, as well as to promote dental hygiene. The organization, expenditure and work of the association are provided for in the ordinance already proclaimed. According to the provisions, no member is allowed to violate or disobey the rules or the decisions of the association, and those who violate the rules may be reprimanded, or fined not exceeding 500 yen, or their franchise suspended, and eligibility abrogated for a period not exceeding three years.

(b) County and City Dental Association: The dentists in practice in a county or city may establish a county or city dental association. Such association is given the capacity of a judicial officer as in the case of the perfectural association. But the formation of such an association is not compulsory, and so may be dissolved at will.

(c) The Japan Dental Association: The present Dental Federation of Japan is a combined body of seventy-five prefectural, county and city associations (where prefectural ones are not yet formed), covering all the localities of Japan and her territories. This federation may be, by the revised law, reorganized under the new name "Japan Dental Association," and the new system, empowered as a judicial person, enrolling all the prefectural associations as its members except those in the territories.

According to the revised law, all the prefectural associations should be organized by Sept. 20, 1926. If the dentists in a locality do not take the necessary steps toward the formation of

a prefectural association, the governor of the prefecture may appoint an organizing committee and expedite the establishment of the association. Therefore, the day of the establishment of the Japan Dental Association is not far off.

The complete formation of the dental associations is now urgently needed as the health insurance law is going to be carried out throughout the empire in January, 1927, when, it is expected, these associations will engage in great social plans hitherto unknown to the Japanese public.

PUNISHMENT FOR A PERSON WHO PRACTICES DENTISTRY WITHOUT A LICENSE, A DENTIST WHO HAS DONE AN INJUSTICE, OR A PHYSICIAN WHO HAS PRACTICED DENTISTRY WITHOUT PERMISSION

The dental law provides:

Article X. The license of any dentist who comes under any of the clauses of Article II shall be revoked, when he is *sentenced for a penalty not exceeding six years of penal servitude or imprisonment,* or is fined, or commits a crime in connection with his profession; or his practice shall be suspended for a certain period. The same applies if such event took place before he obtained his license. A dentist whose license has been revoked according to the present article may regain it when the cause stated in the third clause of Article II is removed or the fact that he is repentant is beyond suspicion. The revocation stated in the present Article shall be executed by the Minister for Home Affairs. In the case stated in the second clause, or in the latter half of the third clause, such step shall be taken through the deliberation of the Central Board of Health.

Article XI. Any person coming under any of the following clauses shall be liable to a fine not exceeding 500 yen or a penalty exceeding 10 yen:

1. If he has practiced dentistry without a license.

2. If he has practiced dentistry while his license is under suspension.

3. If he has violated Articles IV 2, V, VI and VII.

Any physician who has announced himself as specializing in dental practice, or any physician who has practiced metal filling, inlay, artificial denture, crown and bridge work, orthodontia and palatal prosthesis without permission from the Minister for Home Affairs shall be liable to the foregoing clause.

When a prefectural governor deems it necessary to punish a dentist according to the provisions of Article X, he should not only report the case to the Minister for Home Affairs, but should also ascertain the views of the prefectural dental association, thus protecting the rights of dentists from improper menace due to abuse of the provisions of the law.

There are not a few who practice dentistry without a license in Japan and they do much harm to patients; hence the provision of Article XI. The Department of Home Affairs, local governments and the dental associations are constantly cooperating to suppress them.

RELATIONS BETWEEN THE MEDICAL AND DENTAL PROFESSIONS

The line of demarcation between medical and dental practice and education was the subject of discussion for a long time, especially after the course of dentistry was given at the medical colleges and as a result of which medical practitioners claimed that they were entitled to practice dental treatment.

The revision of the dental law in 1916 determined the professional functions definitely. A clause has been added to the provision of Article XI to the effect that any physician who wishes to announce himself as specializing in dental practice, or any physician who wishes to practice metal filling, inlay, artificial denture, crown and bridge work, orthodontia and palatal prosthesis is required to obtain permission from the Minister of Home Affairs.

In this connection, it is required that the applicants for this permission are certified as properly qualified to practice dentistry, after studying dentistry exclusively for a certain period at a dental school or institution similarly equipped. Those medical practitioners who announced themselves as specializing in dental practice for a period longer than one year, prior to this revision of the dental law, are excluded from the operation of this regulation.

These medical practitioners, numbering ninety-one in all, might join the dental association at will, but they might also withdraw from the association, freeing themselves from the control of the dental association.

The revised law deems them dentists, by providing an additional clause to Article XI, making it compulsory for them to join the dental association. This revision raised a question for hot debate on the part of physicians who claim that they are entitled to practice dentistry without any restriction and regard it unreasonable to join both the medical association and the dental association. In spite of controversies, the bill passed the Diet.

THE ODONTOLOGIC SOCIETIES

Besides the dental associations mentioned above, there are several dental societies which have as their purpose research in dentistry. Of these, the following societies are worthy of mention: 1. Dai Nihon Shikwa Igakukai (Japan Odontological Society). Organized in 1902, this is the most influential among this kind of societies in Japan, having 2,000 members. It holds regular meetings in Tokyo every month, and a general meeting annually, when the memoirs and work of members are announced and discussed. The proceedings of the society are issued three times a year. 2. Nippon Shikwa Gakukai (Nippon Odontologic Society). Organized in 1917, all the alumni of the Nippon Dental College, numbering 2,500, are members of the society. Meetings, and the publication of its proceedings, are similar to those of the foregoing society. 3. Nippon Shikwa Kokukwa Gakukai (Japan Odontostomatologic Society). Organized in 1918, this society consists mainly of those who are concerned with the chair of dentistry in Tokyo Imperial University. Meetings and publications are similar to those mentioned above. 4. The Alumni Association of Tokyo Dental College. Organized in 1890, the main object of this society is to conduct studies in dentistry. The monthly organ, "Shikwa Gakuho", has already attained its thirty-first year, and the members number 3,800.

THE DISTRIBUTION OF DENTISTS

The number of dentists registered up to August, 1925, aggregated 11,670. Of these, 8,921 dentists were engaged in professional practice in their own or other offices, all joining the dental association, excluding those abroad or in the territories, or who are in the service of the government hospitals.

In proportion to the total population

of Japan, there is one dentist for every 6,869 persons. The number of those registering as dentists during the year 1923 and 1924 were 1,073 and 1,124 respectively, as follows:

Those who graduated from designated dental colleges, in 1923 numbered 331; in 1924, 372. Those who passed the dental examination in 1923 numbered 735; in 1924, 749. Those who graduated from foreign dental schools in 1923 numbered 7; in 1924, 3.

DENTAL SURGEONS IN THE ARMY AND NAVY

In the Japanese Army and Navy, no arrangements have been made for a dental corps, although the Dental Federation of Japan is striving hard for its establishment. The Navy will probably establish a dental corps within a few years.

In the Army, in 1919, the garrison hospitals began to employ dentists, in view of the lessons of the European war. At present, there are fifty-six dentists employed in all, each being stationed at a garrison hospital of the first, second and third classes. According to the provisions regarding their employment, they are accorded the status of surgeon, but they are not enlisted in the regular staff, and are appointed by the directors of the garrison hospitals. Applicants are required to be of robust health, and more than 21 years of age but less than 40 years.

In the Navy, the training squadron for many years was provided with the services of a dentist whenever it put to sea, but, in 1918, the naval stations began to engage dentists, and at present there are all together eight dentists in the Navy, each naval station having two dentists. Their status is the same as in the army.

THE DENTAL PROFESSION IN THE TERRITORIES

Since the promulgation of the dental law by the governor general of Chosen, Korea, in 1913, no one has been allowed to practice dentistry unless he or she has one of the above-mentioned qualifications and has been granted a license either by the governor-general or by the Minister for Home Affairs. Allowed to practice are:

1. Those who come under the first or the second clause of Article I of the dental law or who have passed the dental examination.
2. Those who have graduated from a dental school designated by the governor general of Chosen.
3. Those who have obtained a diploma from a foreign dental school or license for dental practice in a foreign country, and who are recognized by the authorities as properly qualified.
4. Those who have studied dentistry as special students in a dental school designated by the Minister of Education and have passed the examination in the complete course given by such school.

At present, there are ninety-seven dentists practicing in Chosen, and in 1921, they organized the Korean Dental Association. For the purpose of research in dentistry, there is the Korean Odontologic Society. It holds meetings every year.

In 1921, the government of Chosen held its first dental examination, which will be given regularly hereafter. Forty-one persons passed the examination.

Besides these qualified dentists, there are 197 dental practitioners who have been granted localized and fixed period licenses by the governor general for the

purpose of meeting the shortage in dentists in Chosen, although they are not properly qualified.

THE TEXT OF THE REVISED DENTAL LAW (1925)

Article I. Any person who wishes to become a dentist is required to have any one of the following qualifications, and to obtain a license from the Minister for Home Affairs:

1. He must have graduated from a dental college designated by the Minister of Education.

2. He must have succeeded in passing the dental examination.

3. He must not only have graduated from a foreign dental school or have obtained a license for dental practice in a foreign country, but his qualifications must be recognized as equal to what is required by orders.

Article II. Any person coming under any of the following clauses is not allowed to obtain a license:

1. If he has been sentenced for a penalty of more than six years of penal servitude or imprisonment.

2. If he has not attained the proper age, or has been adjudged incompetent or quasi-incompetent, or is deaf, dumb or blind.

Article III. A license may not be granted to a person who has been either punished with six-years' imprisonment or penal servitude and upwards, or fined in connection with medical affairs.

Article IV. The Dentists' Register shall be kept at the Department for Home Affairs, and particulars relating to dental licenses shall be therein registered. Particulars of registration shall be determined by order.

Article. IV. 2. The regulations relating to the opening or management of a dental office or dental laboratory by a person or persons other than a dentist shall be provided for by order.

Article V. No dentist is allowed to issue a medical certificate, write a prescription or treat a patient, unless he personally examines the patient.

Article VI. The dentist or the head of a dental office shall keep a record book, and it shall be preserved for ten years.

Article VII. In no way is a dentist allowed to advertise his art, treatment or qualifications except his degree or title, and his specialty.

Article VIII. Dentists shall establish a prefectural dental association in conformity with the provisions of the imperial ordinance.

Prefectural dental associations may establish a Japan dental association.

Dentists may establish a county or city dental association, according to the condition of the locality.

A prefectural dental association, the Japan Dental Association, and the county or city dental association shall be a judicial association, and shall aim to improve and promote dental sanitary affairs in conformity with the provisions of the imperial ordinance.

Article IX. A prefectural dental association shall be limited within the boundary of a prefecture.

Dentists engaging in giving treatment in a private or public dental office or its branch shall be a member of the prefectural dental association that governs the locality where the above mentioned office is situated.

Article IX. 2. The Japan Dental Association shall be limited within the boundary of Japan proper.

The members of the Japan Dental Association shall consist of members of prefectural dental associations.

Article IX. 3. A county or city dental association shall be limited within the boundary of a county or city, except as otherwise provided in the imperial ordinance.

The provision of the second clause of Article IX shall be applied to a county or city dental association.

Article IX. 4. A prefectural dental Association, the Japan Dental Association, or a county or city dental association may bring a civil suit against a member or members regarding receipts to be collected from the members of the association.

Aritcle IX. 5. Particulars regarding the procedure of establishment, system of organization, bearing and audit of expenditure, punishment for members of prefectural dental associations, the Japan Dental Association, and county or city dental associations, and all other necessary items, shall be determined by the imperial ordinance.

Article X. The license of any dentist who comes under any of the provisions of Article II shall be revoked. When a dentist is sentenced for a penalty not exceeding six-years' penal servitude or imprisonment, or is fined, or commits a crime in connection with his profession, his license shall be revoked, or his

practice shall be suspended for a certain period. The same applies if the act took place before he obtained his license. A dentist whose license has been revoked according to the present article may regain it when the cause stated in the third clause of Article II is removed or the fact that he is repentant is beyond suspicion. The revocation stated in the present Article shall be executed by the Minister for Home Affairs; in the case, however, stated in the second clause, or in the latter half of the third clause, such step shall be taken through the deliberation of the Central Board of Health.

Article XI. Any person coming under any of the following clauses shall be liable to a fine not exceeding 500 yen or a penalty exceeding 10 yen.

1. If he has practiced dentistry without a license.

2. If he has practiced dentistry while his license is under suspension.

3. If he has violated Article IV 2, V, VI and VII.

Any physician who has announced himself as specializing in dental practice, or any physician who has practiced metal filling, inlay, artificial denture, crown and bridge work, orthodontia and palatal prosthesis without permission from the Minister of Home Affairs shall be liable to the penalties listed in foregoing clause.

Article XI. 2. Any physician who announces himself as specializing in dental practice, or who practices metal filling, inlay, artificial denture, crown and bridge work, orthodontia and palatal prosthesis with permission from the Minister of Home Affairs shall be deemed a dentist as regards the application of Article IV 2, the first and third clauses of Article VIII, the second clause of Article IX, and the second clause of Article IX 3.

Article XII. The present law shall take effect on and after the first day of October, of the 39th year of Meiji (1906).

Article XIII. A license for dental practice issued before the present law takes effect shall be valid, even after the present law is in force.

THE CLINICAL SIGNIFICANCE OF DISUSE ATROPHY OF THE ALVEOLAR PROCESS*

By HUGH W. MacMILLAN, D.D.S., M.D., F.A.C.D., Cincinnati, Ohio

THE changes incident to disuse atrophy of the alveolar process can best be appreciated by a study of the physiologically normal alveolar process. It is well known that the jaws of primitive peoples are larger and more massive in structure, and that they exhibit more definite markings for the attachment of muscles than the jaws of modern civilization. The increased size of the teeth has been explained by Cope[1] in the mechanical causes of the origin of dental modifications, as follows: "Increase of size of a tooth, or part of a tooth, is due to increased use, within a certain maximum of capacity for increased nutrition." In accordance with the change in the external characteristics of the jaw, the cancellous tissue is proportionately strengthened. In conformance with the greater occlusal stress exerted by the primitive chewing mechanism, the transition from cancellous to compact bone is less abrupt, owing to the greater equalization of the bending and compressive forces exerted.

The study of cross-sections of the primitive jaw with the unaided eye reveals a definite arrangement of the trabeculae, corresponding to the mechanical requirements of the region under observation. In the molar region, the compressive forces of mastication are met by archlike arrangements of supporting trabeculae, which vary in their spacing according to the amount of force exerted on the occlusal surface. Bending stress, in the molar region, is met by a transition to compact bone along the buccal alveolar plate in the mandibular molars and along the lingual plate in the maxillary molars. In the anterior region, where the incising, tearing and compressive stresses are received, ofttimes at nearly right angles to the long axis of the tooth, the arrangement of compact and cancellous tissue is more complex but follows a definite plan in accordance with the individual peculiarities of the occlusion. The bicuspid region, having its function between that of the incisors and molars, exhibits corresponding transitions in the physical characteristics of the bone.

The adaption of the alveolar process to increased masticatory stress is in conformance to the statement of Koch: "The thickness and spacing of the trabeculae vary with the intensity of the maximum stresses at various points in the upper femur, being thickest and most closely spaced in the regions where the greatest stresses occur."[2] These

*Read before the Section on Periodontia at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

1. Cope: Mechanical Causes of the Development of the Hard Parts of the Mammalia, J. Morphol., 3: 218 (Sept.) 1889.

2. Koch: Laws of Bone Architecture, Am. J. Anat., 21: 268 (March 5) 1917.

differences in structure are beautifully shown in the comparative study of the bone surrounding a molar under heavy stress of mastication, and a molar that has not erupted sufficiently to receive occlusal stress.

The alveolar process, examined histologically, has all the characteristics of true bone. Haversian systems are found in the thin free margins of the alveolus, the number and distribution being proportionate to the nutritional needs. The presence of several complete haversian systems in the larger trabeculae of the cancellous bone gives evidence of the nutritional requirements for the support of the masticatory mechanism. The lamina dura, which transmits the hundreds of pounds pressure from the tooth to the bone beyond, is characterized by myriads of bone cells, nourished not only by the vessels of the peridental membrane, but also by arterial channels piercing the lamina at close intervals. The presence of the haversian systems in the cancellous trabeculae indicates the anatomic mechanisms concerned in "the conversion of the older spongy bone into compact tissue, the circumference of the system corresponding to the haversian space in which the subsequent development of the concentric lamellae took place."[3] These structural readjustments, compensatory in nature, are constantly taking place during the wear of the teeth. The difference in appearance of the alveolar border surrounding a molar with deep cusps from that of a molar with an abraded occlusal surface illustrates the point.

The fact that primitive jaws are comparatively free from pathologic processes has often been recorded by competent observers. Since the use of dentifrices and assorted toothbrushes, and the relieving of "occlusal traumatism" are obviously not responsible for this immunity, it might be well to enumerate some of the local and general factors that are known to be related to this low incidence of oral pathologic processes. The mineral content of food; the influence of the ductless glands; the rôle of the vitamins and light in calcium metabolism; the composition of the saliva; dietary habits; heredity; the general resistance of the patient, and finally, the maintenance of local resistance through exercise are all vitally related to this immunity to caries and alveolar border disturbances.

In regard to the effect of exercise on the alveolar process, a comparison of radiograms of the jaws of primitive peoples with those of the average patient demonstrates a difference in its structural characteristics that is comparable to the changes in the head of the femur resulting from disuse as recorded by Freiberg and Taylor.[4] Contrasted with the primitive jaw, the modern jaw, from the radiographic negative, shows less restistance to the penetration of the roentgen ray; the compact bone appears less dense, and the trabeculae of the cancellous tissue are lighter in construction and less in number, and have not that appearance of solidity. The medullary canal appears larger. The lamina dura is more pronounced and is often in sharp relief against the sometimes almost totally absent cancellous tissue, while, in the primitive jaw, the line of demarcation of the lamina dura is not so easily discernible, owing to the closer spacing of the trabeculae in its immediate vicinity. Associated with these retrograde changes, collectively

3. Piersol: Human Anatomy, Philadelphia, J. B. Lippincott Co., p. 87.

4. Whitman: Orthopedic Surgery, Philadelphia, Lea & Febiger, 1919; p. 234.

known as disuse atrophy, are numerous carious cavities, fillings, recurrent caries, malposed teeth, disturbances of the alveolar border and periapical pathologic processes which are almost totally absent in the primitive jaw.

The statement of Adami that "lowered vitality of disuse appears effective in increasing the susceptibility of infection,"[5] is nowhere better exemplified than in the association of oral disease with disuse atrophy of the alveolar process. Obviously, one of the definite problems of dental prophylaxis is the physical development of the tissues supporting the teeth to such a degree that there will be created a structural framework comparable to that found in the primitive jaws, before described, a structural framework that, viewed histologically, is but an index of the increased number of haversian spaces and haversian systems contributing in much greater abundance the defensive mechanisms of the blood stream.

"Briefly stated it (i. e., traumatic occlusion) consists of an application of occlusal force in excess of that which the tooth (the author evidently here refers to the supporting structures of the tooth) is capable of withstanding."[6] From a physiologic standpoint, excessive application of occlusal force would produce fatigue, which has been defined as having the following attributes: "physiological result of work, passes off followed by rest, benefits the individual by enabling him to perform successive labors with greater ease."[7] The production of fatigue in connection with mastication of modern diets would provoke mirth. Modern etiquette demands the transfer of food from lips to gullet as unostentatiously as possible. Rest following the modern dinner is not necessary for recuperation of the chewing mechanism. Successive masticatory labors are performed with greater ease by recourse to foods that surreptitiously slip down without interfering with conversation. In the type of patient having such food habits, "traumatic occlusion" is rampant.

The amount of force that a "tooth is capable of withstanding" has never been determined experimentally. The changes resulting from the wearing of the cusps and from the loss of the teeth are so gradual that the relations between stress and compensatory activity of the alveolar process are harmoniously maintained in what may be called a normal individual. Clinically, and from the study of specimens, it has been observed that a single remaining molar bearing all the masticatory activities of the teeth that have been extracted more often continues free from caries and alveolar border disturbances, when, obviously, the sum total of the occlusal stress is several times greater than when the other teeth were present. The amount of force that the structures supporting a healthy tooth are capable of withstanding seems to be greater than that which the muscles of mastication are able to generate. When a tooth is under increased occlusal stress, the bone is physiologically adapted to take care of that increase. The point where physiologic stimulation ends and "traumatic occlusion" theoretically begins has not been shown. Before a pathologic process characteristic of overstrain could occur in masticating, the far-reaching limits

5. Adami: Principles of Pathology, Vol. 1, Philadelphia, Lea & Febiger, 1910; p. 403.

6. Stillman, P. R., and McCall, J. O.: A Text Book of Clinical Periodontia, New York, The MacMillan Company, 1922; p. 52.

7. Adami: Footnote 5, p. 398.

of physiologic fatigue, with all its structural changes, such as increased closeness of spacing of trabeculae, increased density of the compact bone and alteration in root formation, would necessarily have taken place. Paradoxically, in the radiograms used to describe "occlusal traumatism," instead of these physiologic changes that are associated with increased stimulation, disuse atrophy, the antithesis of functional stimulation, is more often present. Biologically, it is impossible to have a constructive change caused by increased occlusal stress occurring simultaneously with a destructive change such as disuse atrophy. The presence of atrophic disused muscles associated with a condition diagnosed by others as "traumatic occlusion" further emphasizes the inconsistency. As one of the "factors which introduce traumatic occlusion,"[8] why not include the abnormal occlusal stress produced by overdeveloped muscles of mastication?

The approach of the axial angle to 90 degrees increases the leverage of the tooth against the approximal support and should invariably produce a dissolution of the alveolar border, if "a slight increase in this force brought about through a change in its magnitude, direction, or point of application may render it an injurious agent."[9] The study of specimens and of clinical cases seems to refute this statement. In the absence of other systemic causes of periodontoclasia, the physiologic adaption of the alveolar process around the tooth that has lost its approximal contact by extraction of the adjoining tooth is such that the increased occlusal stress is met by an increased closeness of spacing of the cancellous tissue, denoting a compensatory strengthening of the area under stress, and, in the absence of local and general factors concerned in the cause of periodontoclasia, is associated with freedom from alveolar border disturbances. Conversely, the absence of occlusal wear or exercise in a tooth, under similar circumstances, results in disuse atrophy of the tissues forming the approximal support and is more often associated with resorption of the alveolar border and pocket formations. Has it been observed that "traumatic occlusion" is more often present in the prognathous type, whose alveolar process around the anterior teeth is subjected to considerably more pounds pressure, owing to the greater leverage exerted in incising? And, finally, further discussing the "conditions found to be essential to a complete normality of occlusion,"[10] (1) how has the "normal vertical relationship of teeth to the line of occlusion" been determined, and (2) what is the degree of the angle in the "normal inclination of the roots of the teeth" that has been accepted as normal?

CONCLUSION

The physical development of the alveolar process necessary for an increased local resistance is produced only by adequate stresses of mastication received on the occlusal surfaces. Lack of occlusal stress, whether produced by failure to masticate resistive foods or by grinding a tooth so that "it does not meet its antagonists of the other jaw in any of the movements of mastication,"[11] results in disuse and lowered local resistance. The theory of "traumatic occlusion" is not in accordance with the principles underlying the functional

8. Footnote 6, p. 68.
9. Footnote 6, p. 64.
10. Footnote 6, p. 68.
11. Footnote 6, p. 74.

adaptation of bone. In addition to the prevention of other local and general factors concerned in the etiology of periodontoclasia, the correction of disuse by the exercise of as much occlusal stress as can be exerted by well-developed muscles of mastication is one of the chief factors that, in the words of McCollum, "will result in the formation of a dental mechanism possessing its own barriers of defense."[12]

DISCUSSION

James Gregory O'Neill, Windsor, Canada: We have endeavored vainly to find out Dr. MacMillan's concept of traumatic occlusion. The statements wherein he mentions the effects of traumatic occlusion do not synchronize in the least with the views of those who have studied and know the occlusal concept as defined by Box. When any tooth is subject to occlusal stress and there exists a harmonious relation between the tooth and its periodontium, there is presented the ideal picture of physiologic occlusion. Any stress exerted on a tooth is first transmitted to and then resisted by the periodontal tissues. The alveolar bone is the main mechanical factor in this act of resistance. Physiologic occlusion, therefore, permits the tissues to remain in a healthy and quiescent state, wherein they are able to resist harmful influence of various kinds which bring about pathologic changes in them. And its establishment is the first fundamental requisite in the prevention and treatment of periodontal disease. If the periodontium is able to withstand the forces of occlusion, and there is not initiated any pathologic change in the pericementum, there exists a state of complete coordination. The latter condition must give us a complete balance of the forces acting on a tooth in occlusion; viz., the pressure exerted by the opposing tooth and the resistance of the periodontium. Adami says that cells subjected to stress or tension will proliferate if the circulation continues normal. Conversely, if the stress or tension interfer with nutrition, the cells will atrophy. Realize that, on the periodontium, we have a soft tissue that is about the same thickness as a human hair lying between two hard walls. This tissue plays a twofold rôle, as far as stress is concerned, acting as a cushion in horizontal overloading and as a cushion in axial overloading; that is to say, in horizontal overloading, the pericementum is a stress breaker at the crest and apex, while, in an axial overloading, the stress is taken care of by the oblique group of fibers, the apical group also serving as a cushion at the base. Our bodies, normally, are in a constant state of breaking down and repair. Adami attaches as much importance to overfunction as to disuse or underfunction. These principles applied to the periodontium are brought to bear when the balance of equilibrium of breaking down and repair no longer exist. An erroneous conception has been broadcast of the conditions that prevailed in the mouths of primitive people. A full investigation and examination of the jaws of many hundreds of skulls of the North American Indians and the Esquimos, made at the Royal Victorian Museum at Ottawa, Canada, revealed these facts: Bone breaking was rampant. Often a loss of from 8 to 10 mm. of bone was observed in jaws of the Esquimos and British Columbia Coast Indians, and British Columbia inland and the prairie Indians. Practically no caries existed among the tribes just mentioned, but, strange to say, on looking over the jaws of the Eastern woodland tribes, the opposite condition was found. There was caries in abundance with little breaking of the crest of the bone. Owing to the fact that the foods of the first mentioned tribes were mainly sun dried, much grit got into the food causing cupping on the occlusal surfaces, the result of this being traumatic occlusion. Certainly, in some of these groups, there was no disuse of the muscles of mastication. In fact, all evidence points to great use and strong forces in the muscles of mastication. On the other hand, the Eastern woodland tribes made a practice of raising maize, which they cooked into a soft, mushy food. This was their main diet. In this group, where there was evidence of disuse of the muscles of mastication, little bone breaking was found, but, as mentioned before, caries were much in evidence. "The mineral content of food, the influence of the ductless glands, the rôle of the vitamins and light in calcium metabolism, the composition of the saliva, dietary habits, the general resistance of the

12. McCollum, E. V.: The Newer Knowledge of Nutrition, New York, The MacMillan Co., 1922; p. 433.

patient and the maintenance of local resistance" we agree are vitally related to immunity to caries and alveolar border disturbances. But how are we to control heredity? Our knowledge of the ductless glands is so vague; and though we may feed people certain things, what do we know about assimilation? These alone will not give us a solution of our periodontal troubles. The solution of our problems seems to lie in gaining a fuller knowledge of the use and working of those parts of our bodies that are giving way under our modern ways of living. The periodontium and the teeth are the greatest offenders in this respect. We grant that we must change our mode of living, but, as far as periodontal conditions are concerned, we must first adapt our bodily structures to our mode of living and not our mode of living to our bodily structures.

Arthur H. Merritt, New York City: It is not a little startling to be told that so-called "traumatic occlusion" is not caused by overuse of the teeth, but by disuse, and the height of heterodoxy to follow this with the statement that "pyorrhea is never caused by traumatic occlusion." Yet this, briefly, is the purport of Dr. MacMillan's message. It is, in a word, a flat contradiction of what, in recent years, we have been taught to believe. To be told that traumatic occlusion is a symptom and not a cause, that the underlying causative factor is not overuse but disuse, and to follow these statements with evidence of the most convincing kind, is, to say the least, revolutionary. In general, I believe that Dr. MacMillan is right. Disuse atrophy of the supporting tissues of the teeth, with its concomitant of lowered cell-resistance and bacterial invasion, is undoubtedly the underlying factor in most, if not all, of the diseases affecting the periodontium. How to overcome this under conditions of modern civilization is the task belonging to periodontia. Dr. MacMillan's clear cut and convincing contribution to the subject is going to make that task easier, in that it focuses attention directly on the one factor that must be corrected in any attempt at the successful prevention and treatment of periodontal diseases.

Dr. MacMillan (closing): Examples of overstress given by Adami include "cardiac inadequacy, writer's and pianist's cramp, and the labioglossal paralysis of flute players." So far, there have been no cases recorded of cramps or paralysis of the masticatory muscles due to excessive function. If "axial overloading" were possible in the modern diet, the five to twelve hours' rest between meals would be ample time to restore the altered "balance of equilibrium." Before discussing "bone breaking," a term which has been used in connection with the Eskimos' skulls, it would be advisable to have defined this new addition to the nomenclature. The term is not found in Adami. Unless observations of this kind are made by men thoroughly qualified in bone mechanics, the absence of bone over certain teeth may be interpreted as pathologic, when a more discriminating diagnosis reveals that this condition is in accordance with the structural requirements of the part. One of the chief aims of this paper has been to show that the complex described as "traumatic occlusion" is not a primary etiologic factor in the production of retrogressive alveolar border disturbances.

BASES FOR PROGNOSIS IN ORAL EPITHELIOMAS*

By A. P. STOUT, M.D., New York City

IT is customary for writers, when dealing with oral cancers, to stress the importance of treating these neoplasms at an early period in their course in order to have any chance of a successful outcome. They give one the impression that any neoplasm, if taken early enough, can be dealt with successfully and, conversely, that there comes a time in the course of all oral epitheliomas when they may be described as "hopeless." While subscribing to the probable truth of the second half of this statement, it has seemed to me that the first half is in need of a certain amount of critical comment. After studying fifty-three cases of oral epithelioma[1], the number found during the ten year period from January 1, 1915, through December 31, 1924, at the Presbyterian Hospital, New York, we found that, in the operable cases, the duration of symptoms before treatment apparently had little bearing on the result. The average duration of symptoms before treatment in the cases that had good results was five and four-tenths months; of the undetermined cases, three months, and of cases having bad results, five and five-tenths months. On the other hand, certain observations were collated suggesting that there were some other factors which could be used with better success in predicting results. The observed factors that seem to aid one in prognosis are: (1) the relative degree of differentiation, (2) the anatomic site, and (3) the presence or absence of metastases.

In 1921, Broders[2] called attention to the observation that it was apparently possible to tell the relative degree of malignancy in epitheliomas by determining to what extent the cells were differentiated. He divided neoplasms into four classes of differing malignancy by this method. We found it impracticable to subdivide to such an extent, and simply employed two classes: the well and the poorly differentiated. The criteria that we used were as follows: The less malignant well differentiated epithelioma showed a tendency to reproduce in its growth all of the epithelial layers of the mucous membrane; it did not infiltrate deeply but tended rather to form a mass projecting into the oral cavity; the line of infiltrating cells formed a relatively uniform curve instead of an irregular one that it was

*Read before the Section on Maxillofacial Surgery and Surgical Prosthesis at the Seventh International Dental Congress at Philadelphia, Pa., Aug. 24, 1926.

1. These fifty-three neoplasms were found among 203 cases of tumors of all kinds in and around the oral cavity. For various reasons, the twenty-eight lip epitheliomas are not dealt with in this paper. The total number of neoplasms at the Presbyterian Hospital during this ten year period was about 3,961.

2. Broders, A. C.: J.A.M.A., 74: 654 (March 6) 1920.

difficult to follow; there were relatively few mitotic figures, and the rate of growth was relatively slow. Conversely, the poorly differentiated more malignant neoplasms did just the opposite. Often, neoplasms were found with the characteristics of both classes, and then it was necessary to classify them according to their predominating traits.

In 1925, Simmons[3] made the observation that more malignant epitheliomas were found in some parts of the oral cavity than in others. The floor of the mouth (including the tongue) was the site of the greatest number of malignant growths, while the lower jaw, the cheek and the upper jaw were the sites of relatively fewer ones in the order named.

In regard to metastases in the submaxillary or cervical lymph nodes, it is only necessary to say that, at the Presbyterian Hospital, we do not know of any good results from treatment in cases in which lymph node metastases were found at any time during the course of the disease.

In the following tables, the attempt has been made to show how the application of these three criteria worked out in helping to predict the probable results of treatment based upon the observed results at the Presbyterian Hospital. The terms used are as follows: A *good* result constitutes freedom from signs of the neoplasm five or more years after the beginning of treatment. The *bad* results constitute deaths from treatment or the neoplasm or persistence or reappearance of the neoplasm. The *undetermined* are those in which patients are alive without signs of the neoplasm less than five years after the beginning of treatment.

TABLE 1.—FORMS OF TREATMENT AND NUMBER OF CASES TREATED

Lower mouth	Cases	Radical Operation	Other Treatment	No Treatment
Tongue	21	12	3	6
Floor of mouth	4	1	2	1
Gum mandible	12	6	3	3
Cheek	4	4	0	0
Tonsil	1	0	1	0
Upper mouth				
Gum maxilla	4	3	0	1
Palate	4	3	0	1
Maxillary and sphenoidal sinuses	3	2	1	0
Total	53	31	10	12

The forms of treatment used and the number of cases treated in each part of the mouth are shown in Table 1.

"Other treatment" refers to radiation either by radium or roentgen ray, partial or incomplete excision and cauterization. It should be noted that surgeons dealing with these cases have preferred radical removal whenever the case seemed operable, and radiation has been used only in "hopeless" cases, and sometimes as postoperative treatment.

The first criterion, that of differentiation, has been relatively unreliable in our experience.

The proportion of good and unde-

3. Simmons, C. C.: Am. J. Roentgenol., 13: 545-550 (June) 1925.

termined results in the well-differentiated classes to the total number of cases in those classes is more than twice as high (44.4 per cent) as is the proportion in the poorly differentiated class (17.6 per cent). It can easily be seen that this is far from a reliable criterion when taken alone.

TABLE 2.—DIFFERENTIATION

	Cases	Results: Good	Undetermined	Bad	Not Followed
Well differentiated	9	1	3	3	2
Poorly differentiated	34	3	3	23	5
Unknown	10	0	0	9	1
Total	53	4	6	35	8

two epitheliomas arising in the sides and the lower part of the oral cavity, we cannot record a single good result and only three undetermined cases. In sharp contrast, the eleven epitheliomas in the upper part of the mouth and adjacent sinuses show seven good and undetermined results and only two bad ones. These figures confirm Simmons' observation in a striking manner.

TABLE 3.—RESULTS ACCORDING TO ANATOMIC SITE

	Cases	Results: Good	Undetermined	Bad	Not Followed
Lower mouth					
Tongue	21	0	1	18	2
Floor of mouth	4	0	0	2	2
Gum Mandible	12	0	1	9	2
Cheek	4	0	1	3	0
Tonsil	1	0	0	1	0
Upper mouth					
Gum maxilla	4	1	1	0	2
Palate	4	2	1	1	0
Maxillary and sphenoidal sinuses	3	1	1	1	0
Totals	53	4	6	35	8

The results in cases grouped according to anatomic site are given in Table 3. This chart shows that of the forty-

Finally, there is the factor of me-

tastases in the submaxillary or cervical lymph nodes. (Table 4.)

TABLE 4.—METASTASES

	Cases	Results: Good	Undetermined	Bad	Not Followed
No metastases	20	4	6	8	2
Metastases	28	0	0	24	4
Unknown	5	0	0	3	2
Totals	53	4	6	35	8

From this table, it is made clear that, in this series, all of the good and undetermined results had no metastases at the time when the patient came for treatment and that there has not been a single favorable result obtained in any of the cases that had metastases. As a corollary to Tables 3 and 4, it may be stated that the percentage of metastases from the epitheliomas of the lower part of the mouth is 64.2 per cent, while in the upper part of the mouth it is only 27.2 per cent.

Those who prefer radiation as a form of treatment may object to drawing conclusions from these figures on the ground that surgery has been the principal form of treatment in the

TABLE 5.—SUMMARY OF CASES

Lower mouth	Cases	Metastases	Differentiation: Good	Poor	Unknown	Results: Good	Undetermined	Bad	Not Followed
Tongue	21	14	0	13	8	0	1	18	2
Floor of mouth	4	2	1	2	1	0	0	2	2
Gum mandible	12	7	3	9	0	0	1	9	2
Cheek	4	3	1	3	0	0	1	3	0
Tonsil	1	1	0	1	0	0	0	1	0
Upper mouth									
Gum maxilla	4	2	1	3	0	1	1	0	2
Palate	4	0	1	2	1	2	1	1	0
Maxillary sphenoidal sinuses	3	1	2	1	0	1	1	1	0
Totals	53	28	9	34	10	4	6	35	8

clinically favorable cases. In reply to this possible objection, it may be said that the published reports of Quick,[4] Simpson,[5] Grier,[6] Stevens,[7] and Hanfords,[8] all of whom have used radiation, have been studied and compared with the results published by Simmons,[9] Judd and New,[10] and Bloodgood,[11] who favor surgery, and little difference has been noted.

The information which has been presented is summarized in Table 5.

4. Quick, D.: Ann. Surg. 73: 716-723 (June) 1921.

5. Simpson, F. E.: J. Radiol. 6: 5-7 (Jan.) 1925.

6. Grier, G. W.: Am. J. Roentgenol. 12: 347-352 (Oct.); 11: 537-544 (June) 1924.

7. Stevens, R. H.: Am. J. Roentgenol. 11: 532-536 (June) 1924.

8. Hanford, C. W.: J. Radiol., 5: 55-57 (Feb.) 1924.

9. Simmons, C. C.: Boston M. & S. J., 191: 1018-1022 (Nov. 27) 1924.

10. Judd, E. S., and New, G. B.: Surg. Gynec. & Obstet., 36: 163-169 (Feb.) 1923.

11. Bloodgood, J. C.: J.A.M.A., 77: 1381 (Oct. 29) 1921.

CONCLUSION

I believe that evidence has been offered by this study favoring the hypotheses (1) that epitheliomas of the lower part of the oral cavity are much more apt to be malignant than those of the upper; (2) that the presence of metastases in lymph nodes is of extremely grave prognostic significance, and (3) that the degree of differentiation in an oral neoplasm, as interpreted by me, while not of sufficient accuracy to be of vital prognostic value when taken alone, is of some assistance when taken in conjunction with a consideration of the anatomic site and the presence or absence of metastases.

RECOLLECTIONS OF LISTER*

By C. EDWARD WALLIS, M.R.C.S., L.R.C.P., L.D.S.R.C.S., London, England

AS I suppose that I am possibly the only living dental surgeon† who actually served under Lister, the "father of antiseptic surgery," it occurred to me that some of the members of this congress might be interested in hearing something of so great a man, "firsthand," as we say in England.

In the spring of 1891, I was appointed one of Lister's surgical dressers. He was then approaching the age for retirement from active hospital practice, and it may be interesting to recall how it was that Lister came to London, since when the invitation came, he was the leading surgeon in Edinburgh.

The death in 1877, of Sir William Fergusson, who had been the leading operator of his time, left a vacancy at King's College Hospital, and the governing body looked about for someone to take his place. The invitation was extended to Lister who, since 1876, had been preaching the then revolutionary doctrine of "antiseptic surgery."

*Read before the Section on History, Science and Libraries at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 25, 1926.

†Dr. Wallis died January 4 of this year.

The appointment of an Edinburgh surgeon to a great London teaching hospital was looked on by the medical profession with amazement.

Lister was to find, as his colleagues at King's College Hospital, two notable men, namely, John Wood, famous for his so-called "radical cure of hernia," and Henry Smith, who specialized in the treatment of hemorrhoids.

As far back as 1873, that is, four years previously, John Wood had publicly denounced "antiseptics," and you can therefore imagine his feelings when Lister was appointed his colleague. The position was made infinitely more difficult for both John Wood and Henry Smith as Lister was at once appointed senior surgeon over the heads of them both, a bitter pill indeed for John Wood in particular, as he had been on the staff for many years and naturally looked for preferment.

Before Lister accepted the post, he had made certain conditions, insisting on bringing with him his two house surgeons (one of whom was Watson Cheyne, afterwards president of the Royal College of Surgeons of England) and, in addition, dressers and nurses trained in his antiseptic methods.

When I first came in contact with Lister, in 1891, "Sir Joseph Lister" as he was then called, he was known familiarly and irreverently by his dressers and pupils as "Joey."

The "Listerians," as we were called, were somewhat sneered at by the other students, who made sarcastic remarks at our expense, casting doubt upon our antiseptic claims and declaring that "Lister never taught any surgery," and that he was useless as an examination teacher.

It is true that, when we went up for our examination in surgery at the Royal College of Surgeons, we had to be extremely wary in what we said. The examiners of those days, being mostly elderly surgeons brought up in preantiseptic methods, were very suspicious of our antiseptic claims, and indeed indignant when we suggested wiring as the proper treatment for a fractured patella.

There is no doubt that Lister felt very keenly the fact that, whereas, in Edinburgh, he was idolized by his students and lectured to crowded and enthusiastic classes, in London he was to some extent isolated and aloof from his professional brethren.

Once or twice weekly at King's College Hospital, he would give a clinical lecture in the operating theater before commencing his operations.

This would, as a rule, be on some simple surgical subject, which he would utilize for expounding his antiseptic principles, with special emphasis on the minutest details. It is sometimes stated that Lister did not teach asepsis and did not foresee aseptic surgery. This is an entire fallacy. I have myself heard Lister speak on the subject of "aseptic surgery" as being the ideal, but he did not consider it safe or suitable in a teaching hospital, where surgeon assistants, dressers and nurses were constantly being changed.

It is sad to relate that his audience was often limited to his own house surgeons and personal staff as far as King's was concerned, though many foreigners attended in the summer months (causing us much amusement with their profound bows on entering Lister's presence).

When the lecture was over, Lister would commence his operations, and I am just old enough to recall the horrible discomfort of the so-called "anti-

septic spray," the manipulation of which was the duty of one of the dressers, who kept steam up and directed the spray on the wound. Its use was abandoned at King's in 1887, though, strange to say, it was used as late as the early nineties at Guy's Hospital.

It is hard to imagine the difference in the operation ritual of those days as compared with that of the present, no masks, no rubber gloves, not even a sterilizer!

Lister would begin by taking off his broadcloth frock coat and putting it in a cupboard from which he took an old one, showing unmistakable signs of previous surgical use. Having put it on, he undid his cuff buttons and turned the sleeves half way up on his arms. Should the operation promise to be specially sanguinary, he would, in addition, turn up his coat collar and turn in the lapels. He then thoroughly washed his hands and soaked them in 1:20 carbolic lotion which we then though contained all necessary elements for antiseptic procedure.

In those days, it was customary for Lister and his surgical colleagues to have, each, three surgical clinical clerks, as they were called, and a proportionate number of junior surgical inpatient dressers. The clinical clerks had already acted for six months as junior dressers, so that, by the time one became a clinical clerk, he was a comparatively experienced person.

Of the three clerks, one acted as anesthetist for two months and gave the chloroform, which was Lister's invariable anesthetic. A second prepared, sterilized and handed the instruments, as required, to Lister, and the third did accident duty for two months in the casualty department of the hospital.

The two months were not consecutive as we each did two separate months out of the total of six, so that, by the termination of our dresserships, we were certainly, for our age, experienced.

The sterilizing process of those days consisted, first of all, in a thorough cleaning of the instruments, after which they were soaked in 1:20 carbolic lotion for several hours before the time of operation.

It is remarkable that no one at that time had thought of boiling the instruments, and as for a sterilizer, no such appliance appeared for many years.

As regards surgical dressings, Lister then used his recently introduced cyanid gauze, which was mauve and provided material for an amusing hospital chorus based upon the various colors used in Lister's dressings.

Before the actual operation, the operative area had to undergo a process of preparation. After a thorough washing and shaving, the part to be operated on was scrubbed with a horrible lotion known as "strong mixture," consisting of 1:500 perchlorid of mercury and 1:20 carbolic lotion. As can be imagined, this was extremely irritating. When applied to the tender skin of the abdomen, it sometimes caused intense irritation, and when I recalled the condition of our hands, I almost shudder, so sodden and cracked did they become after a month or so of this work. We carried with us a perpetual odor of carbolic acid.

Iodoform was also greatly used in those days for powdering open wounds, and as it was said not to be sterile, we actually had the iodoform sterilized with 1:20 carbolic. Sir Watson Cheyne used to instruct us always to use iodoform for venereal sores, as it was an excellent danger signal.

Lister also introduced a dressing which we called "mud," composed of the powdered cyanid of mercury and zinc made into a paste with carbolic lotion. This was applied as an antiseptic to hairy areas and appeared very efficacious when applied to cut heads, of which we then had an abundance on Saturday nights.

Should an instrument be required unexpectedly at an operation and be unsterilized in the cupboard, it was dipped in undiluted carbolic acid and then considered safe.

As to the anesthetic clerk, perhaps a word may be said. The plan of allowing chloroform to be administered by senior students caused much adverse criticism and comment at the time among other surgeons, and especially by the professional anesthetists, who were never asked to assist at Lister's operations.

In accordance with the Edinburgh custom, Lister pinned his faith entirely to chloroform and would allow no other anesthetic to be used. One of his chief clinical lectures was on the subject of chloroform administration, wherein he would give the minutest details as to the proper procedure.

Lister held that it was unnecessary to auscultate the patient's heart beforehand as it was the respiration that failed, and that it was the respiration that should be watched.

The procedure was simple. A towel was folded into a cone to reach from the bridge of the nose to the top of the chin and then fastened by a safety-pin.

It was held at first a few inches above the patient's face and gradually lowered as he became accustomed to the vapor.

Lister enjoined special care during the struggling of dangerous period, as he called it, and always satisfied himself that anesthesia was complete before commencing to operate.

When the patient was sufficiently anesthetized, Lister proceeded to operate, the operative area being surrounded by towels wrung out of hot carbolic lotion and changed as required.

In his latter days, Lister, as I saw him, was not a brilliant operator. He did only comparatively simple operations, as we should view them today, the most complicated being an excision of the wrist for tubercles or the wiring of a fractured patella.

He loved, above all things, a compound fracture, which gave him his chance, being the original surgical procedure with which he had startled an incredulous surgical world.

His operating had then became slow and was in vivid contrast to the brilliance of his surgical colleagues, who had been brought up in the days when rapidity was an essential feature of every operation. He invariably broke out in a profuse sweat all over his head a few minutes after commencing to operate, and I have frequently seen large drops of sweat fall into the wounds, which were promptly sterilized with 1:40 carbolic lotion. A nurse was always at hand to wipe his brow in order to avert this mishap.

Lister used to visit his wards every afternoon in order to dress the operative cases himself. He would have with him his house surgeons, clerks and dressers as well as the ward sister, but seldom anyone else connected with King's. Distinguished foreigners were constant attendants, and Lister would explain to them every step of his procedure in deliberate French or in equally deliberate German, and even, occasionally, in Italian.

It was only the unimportant cases that the junior dressers were allowed to dress.

His wards were, in those days, filled largely with old chronic cases which had been under his care for months and even for years, and when his assistant surgeon took his place during the summer vacation, the latter made it his business to clear these old cases out of the hospital in order to provide beds for more operations.

When Lister returned after the holidays and found the chronic cases gone, his expression was grave, though he said nothing within our hearing.

It will be seen with what derision Lister's surgical teaching was looked on by the other students. His house surgeons were always being taunted by their colleagues, who refused to believe there was no pus in any of the so-called "clean operations." The fact that sepsis frequently followed surgical interference was looked on as more or less inevitable.

Henry Smith, already referred to, used openly to deride Lister in his clinical lectures. He laughed at his antiseptic lotions and irrigation during operations. He declared that he always made big incisions so that when Lister's germs got in at one end, there was plenty of room for them to crawl out at the other. He always insisted that he got just as good operative results without antiseptics, and as 70 per cent of his operations were for hemorrhoids, he was probably right.

It was a great surprise to London surgeons when Lister took a house in Park Crescent, which was outside the sacred area of Harley Street. They said that he would never get any consulting practice there! As a matter of fact, patients were sent to him from everywhere except London itself. Lister's reason for residing in Park Crescent was that he detested an ordinary street, and had been accustomed in Glasgow and Edinburgh to meditate in open spaces. The gardens opposite his house, and Regent's Park close by, were well suited for this purpose.

It was a long time before Lister became popular with London practitioners, and the reason will readily be seen. Should an operation be deemed necessary, he always insisted that only his own skilled assistants should assist, and that either he, or his nominee, should perform the subsequent dressings. You can see how this idea damned him in the estimation of the general practitioners, who complained that it was taking the case out of their hands.

It is, of course, evident that any other course would have jeopardized Lister's successful results, and it was essential that, if his teaching was to gain ground, it must be free from failures. There were few surgeons who had had any antiseptic training, and as for the ordinary general practitioner, he looked on suppuration and the inevitable poultice as the usual sequel to an operation.

HISTORICAL

Lister was born in 1827 at West Ham, of Quaker parentage. Part of his education was conducted at a Quaker school, Grove House, Tottenham. He was a student of University College in 1844 and took his B. A. (London) in 1847 and M. B. (London) and F. R. C. S. in 1852. He went to Edinburgh, where he assisted Professor Syme, whose daughter he had married. He was appointed assistant surgeon at the Glasgow Infirmary in 1856, at the age of 29. There he remained till 1867, when he was appointed to the chair of clinical

surgery at Edinburgh, just about a year after he had started his life work, the antiseptic treatment of wounds. He had previously made an attempt to get back to London at University College Hospital by applying for the post of assistant surgeon, but John Marshall received the appointment.

By 1868, Lister had enthusiastic disciples in Australia, St. Petersburg, North America and elsewhere. It was at about this period that he opened a knee-joint for loose cartilage. The surgical wiseacres denounced this as criminal, although, much to their astonishment, the patient made a rapid recovery.

In 1867, he made his epoch-making discovery that ligatures could be safely cut short and left buried in the wound. He had worked at this for some time and finally tied the carotid of an old horse with carbolized silk. For this purpose, he selected a moribund old animal which died a natural death, six weeks later. He performed a postmortem on the animal and found the artery occluded and no sign of suppuration. So he tied the internal iliac of a human being in 1868 for aneurysm, burying the ligature, with a similar result. Curiously enough, the patient died ten months later, and Lister found signs of suppuration at the site of the ligature. So he began to distrust silk and thought of catgut, which he manufactured from the submucous coat of a sheep's intestine. He first experimented with this on a young calf, which was slaughtered a month later. The ligated part was forwarded to Lister, who found the catgut had been absorbed and replaced by living tissue.

Still, at Leeds in 1869, at the annual meeting of the British Medical Association, the antiseptic system was pretty generally denounced.

In 1871, Lister gave the address on surgery at the annual meeting of the British Medical Association at Plymouth, in which he regretted that his theory was making little headway in London.

As late as 1873, John Wood, already referred to, at the annual meeting of the British Medical Association, held in London, denounced antiseptics, while at the same period, Bardeleben, of Berlin, by embracing Listerism, had banished pyemia from his hospital practice.

In 1879, at the British Medical Associating meeting at Cork, the surgical address was made by Sir William Savory of Bart's, Lister's great opponent. He said that fifty-two deaths that year at Bart's from pyemia, septicemia and erysipelas was quite a good result. Savory was at about this period, one of the examiners at the Royal College of Surgery and it was a commonly given tip among the candidates from King's that, if they came before him, they should not mention antiseptics. If they did, Savory "ploughed" them.

In this same year, 1879, when the International Medical Congress met at Amsterdam, Lister attended and received a magnificent reception. When this was reported in London, the chief surgeons there began to wonder whether there might not be something after all in the antiseptic theory. So a meeting of the British Medical Association was held at St. Thomas's Hospital in December, 1879, at which the discussion lasted two nights. Lister attended and gave an address, which was followed by the addresses of other eminent surgeons.

To emphasize the ultra conservatism of London surgeons: It was hard to find a dozen of them competent to carry out intelligent antisepsis for many years

after Lister came to the King's College Hospital. The system roused no enthusiasm among them, but his teaching seems to have come back to England, refurbished, from Germany, as a novelty. The provinces had been more promising, for many provincial surgeons had been getting good results by adopting Lister's methods.

Lister is said to have been the only surgeon who ever operated on Queen Victoria. She had an abscess in the armpit, which he opened, at Balmoral, under an ether spray, which was worked by Sir William Jenner.

The operation was followed by a recrudescence of the swelling, over which Lister cogitated while walking in the castle grounds. He cut a piece of rubber tubing from the spray apparatus, soaked it all night in carbolic lotion and pushed it through the incision into the cavity, after which the royal patient made a rapid recovery. What faith Lister had in himself when he made his first experiment with a rubber drainage tube on the person of the Queen of England! Afterwards, he used such tubes ordinarily in his practice.

Lister was also in consultation with Sir Frederick Treves over King Edward's appendicitis, which attacked him on the eve of his coronation in 1902.

In 1874, when the antivivisectionists were making a great fuss and were keeping themselves very much before the public, Queen Victoria was more or less "got at" by them, with the result that, in 1875, she wrote a personal letter to Lister asking him to use his influence against it.

Lister made a frank and fearless reply. There was little of the courtier about him when what he considered his duty to mankind was at stake. And this was the man whose name was greeted with cries of "Brute!" when mentioned at antivivisection meetings.

Lister was, to some extent, a misunderstood and disappointed man in his own generation, disappointed, I think, because his English colleagues did not take his revolutionary teaching seriously and made little effort to master the essential rudiments of antisepsis.

As regards dentistry I never remember Lister either extracting a tooth or even referring to the subject of teeth. Nevertheless, the influence of his teaching on our work has been just as profound as on other branches of surgery, and, therefore, to him, we, like our surgical brethern, owe a debt that no tongue can adequately express.

In 1897, Lister was raised to the peerage and a great banquet was given to him by his old pupils, at which I was present.

On his eightieth birthday, in 1907, Lister was the recipient of telegrams and floral tributes from all parts of the world, so much so that the hall of his house in Park Crescent was a bower of flowers, while Lister himself, having outlived his wife and family and friends, was dining by himself in silent solitude.

After several years of ill health and solitary old age, he passed away, in 1912. He was buried in Westminister Abbey in the presence of representatives of the whole of mankind, for whom he had devoted all the years of his life.

A REVIEW OF THE WORK ON THE LYMPHATICS OF DENTAL ORIGIN*

By FREDERICK B. NOYES, B.A., D.D.S., Chicago, Illinois

AT this time I had expected to report some additional work on the subject of the lymphatics of the dental region, but as it has been impossible to bring this work to a point where it can properly be reported, I shall present a review of what has been done, in the hope that some other workers will be stimulated to verify the results and extend the work.

Kohner of Berlin was apparently the first man to attempt to inject lymphatic vessels in the dental pulp. In an article published in Berlin in 1897, under the title "Concerning the Relationship between Pathological Conditions of the Teeth and Chronic Swellings of the Lymphatic Glands of the Neck," Kohner reviewed the early opinions and theories regarding this subject. These are interesting but not important.

It is apparent that, from clinical observations, men were led to suspect that there was some means by which infection was carried from the pulps of broken down temporary molars in children to the lymphatics of the neck.

In 1897 and 1898, Kohner, Ollendorf and Stahr published articles on this subject. These men were exceptionally skilful in the technic of lymphatic injection, and when, after persistent endeavor and the use of all known technical skill, they failed entirely to demonstrate the presence of lymphatic vessels in the dental pulp, they were justified in the conclusion that these vessels did not exist. In spite of his inability to inject lymphatic vessels, Kohner seems to have been still of the opinion that the dental pulp was possessed of powers of absorption. This theory was based upon experiments in which he placed substances on the pulps of living animals, and was able later to demonstrate them in the lymphatic spaces of the glands of the neck. The publication of the negative results of the injection by these three men seems to have spread all over the world, and, from 1900 until 1910, it was generally accepted that the dental pulp was devoid of lymphatic vessels. It was the statements made in textbooks on pathology and in article on pathology appearing during this time that first interested me in the subject.

About 1914, working with Dr. Kaethe Dewey in the laboratories of the University of Illinois College of Dentistry, I undertook an investigation of this

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subject. In examining the literature, Dr. Dewey soon found that Schweitzer of Berlin had published reports on injections of lymphatic vessels in the dental pulp,[1] and that his work had been quoted by Testut, in the last edition of his "Treatis on Human Anatomy." It appeared, therefore, that the demonstration of lymphatic vessels in the dental pulp had already been made, because the authenticity of this demonstration has been recognized by authorities in anatomy and by other investigators of the lymphatic system. Clearly, therefore, the first thing to be done was to attempt to repeat the work of Schweitzer and to determine whether we could reproduce his results.

Schweitzer's work was entirely different from that of the earlier investigators, and was based on different reasoning. First, he used the Gerota injecting mass, an exceedingly mobile liquid, made by grinding 2 gm. of Berlin blue (we used the oil color in tubes), made up, I think, by Windsor Newton, with 3 gm. of oil of turpentine. The two should be thoroughly rubbed together in a glass mortar and then 15 gm. of sulphuric ether added. After thorough mixing, it should be filtered through flannel or chamois skin. This blue liquid mass will pass with the greatest ease through the most delicate vessels. Secondly, he reasoned that if the dental pulp did contain lymphatic capillaries, they undoubtedly were connected with the net work of capillaries that was known to exist in the gum tissue, and over the labial surface of the alveolar process; that, if he could break into this network in the gum tissue, the injecting mass could be forced backward into the vessels of the dental pulp and the peridental membrane. He first injected the blood vessels, I believe, with gelatin carmine so that the blue Gerota mass could be easily distinguished from the red mass in the blood vessels. In repeating his work, we used dogs and rabbits. We found that the best material was young dogs, preferably of a large breed, and whose permanent teeth had just erupted. The first work of Dr. Dewey and me was reported in April, 1917.[2] We succeeded in confirming Schweitzer's work most satisfactorily. In fact, it seemed at the time that our results were more satisfactory and conclusive than Schweitzer's as indicated by the published illustrations accompanying his report.

In working backward from the lymphatic capillary network of the gums and alveolar process, we used an ordinary Luer syringe, with a steel hypodermic needle in place of the fine glass catheters that had been used by previous workers. It is apparent that, in this method, the extreme delicacy of the cannula is not essential. It is not supposed that the cannula enters any capillary lymphatic vessels, but that what probably occurs is this: The needle catches and tears a large number of these extremely delicate vessels. The injecting mass forms a larger or smaller lake in the intercellular tissues, and from this lake, the injecting mass is forced into the injured lymphatic capillaries by the pressure exerted on the fluid by the barrel of the syringe and by

1. Schweitzer: Arch. Microscopic Anat. & Embryol., 69: 807, 1907; 74: 927, 1909.

2. Dewey, Kaethe, and Noyes, F. B.: Dent. Cosmos, 59: 436 (April) 1917.

the continuous massage maintained over the area for a considerable time. The injecting mass is, therefore, picked up by drainage channels and forced laterally and backwards through the anastomosing channels of this exceedingly delicate network. Anyone who has studied the character of these extremely delicate vessels can readily understand how this might occur. By the Schweitzer method we were able to show lymphatic vessels extending through the entire length of the dental pulp. These were both perivascular and independent in character. They were, in some instances, traced to the odontoblastic layer, and some very suggestive fields were observed where the injecting mass seemed to surround odontoblastic cells and even extended slightly into the dental tubules. These vessels were perfectly definite in outline and even in character, and it was impossible to suppose that the injecting mass had simply been forced through into fibrous spaces. I was interested in one comparison: G. V. Black, in the "American Text Book of Operative Dentistry," describing the progress of infection in the dental pulp, says that the infection progresses along the course of the blood vessels, extending most rapidly in the central portion of the pulp toward the apical end. I have, in my collection, microscopic sections from which the illustrations were made. In these sections, Dr. Black has beautifully stained the micro-organisms so that they can be seen in the tissues surrounding the blood vessels. From a comparison with our material, it would appear that these micro-organisms are not simply in the tissues outside the blood vessels but that they actually lie in the perivascular lymph vessels that surround the blood vessels. The conviction that this is the case is inevitable after careful study of the sections.

After successfully repeating Schweitzer's work, we reasoned that if it was possible to inject lymphatic vessels in the dental pulp from communications with lymphatic capillaries in the gum tissues, it should be possible to carry the injecting mass through the lymphatic vessels of the dental pulp, and trace their course to the lymphatic glands. In order to test this, we decided to try on several animals the following procedure: Brass cannulas were made with tapering points to fit as exactly as possible into a hole made by a special drill. Young dogs were anesthetized and the blood vessels were injected in the usual way. With a drill, a hole was made through the labial or buccal surface of the canine and first molar, both upper and lower; the brass cannulas were tightly inserted in the opening, and the cannula was filled with the Gerota injecting mass by means of a finely drawn glass pipet in such a way as to exclude all air bubbles. Pressure was exerted on this fluid through a rubber tube connected with an air pressure tank. A pumping, or pulsating, character was given to the pressure by compressing the rubber tube with the fingers in the palm of the hand, and this seemed to facilitate the results. I believe about ten animals were used in this way, with absolutely negative results. Finally, during the process of a blood injection, an accident occurred, the cannula slipping from the blood vessels before the injection was completed, and this experiment gave one of the most perfect lym-

phatic injections that we obtained in the entire series. Later, by making the lymphatic injection first and the blood injection afterwards, it was possible to obtain positive results in most cases. It is perfectly evident that, when a perfect blood injection is obtained, a condition is produced in the dental pulp which is in no sense normal, but which corresponds to the condition in acute hyperemia. All of the blood vessels are filled and distended with the injecting mass, and the surrounding tissues are compressed between the distended blood vessels and the resistant wall of the dentin. In this condition, all of the lymphatic vessels are so completely compressed that it is impossible to force any material into them or through the apical foramina. After both lymphatic and blood injections were completed, the head was severed from the body, the skin was removed and the real work began. Working with a Zeiss binocular loop and tweezers, the subcutaneous tissue and fat was carefully removed from the region of the infraorbital foramen and the mental foramen. Minute traces of the blue mass were carefully watched for.

To work this way for hours with the nose and eyes within a few inches of a head soaked in a formaldehyd solution required both patience and endurance. When a fine blue thread was discovered, it was followed with the utmost care. Proceeding in this way, it was possible to pick up fine lymphatic vessels filled with the blue Gerota fluid, extending from the region of the infra-orbital foramen, following the facial arteries and extending to the large lymphatic glands of the neck. In the same way, vessels were found emerging from the mental foramen and could be traced along the lower border of the mandible to the first cervical glands of the neck. When these glands were uncovered, the blue lines in them could easily be seen with the naked eye. The lymphatic vessels are not large, but after they have been uncovered, can be seen with the unaided eye. Microscopic sections were made of some of these glands, and the Gerota mass was found lying in the lymphatic spaces in the glands. Microscopic sections also showed injected lymphatic vessels in the dental pulp passing through the apical foramina and through the peridental membrane into the cancellous bone, and surrounding and accompanying the blood vessels and nerves in the inferior dental canal, and in the infra-orbital canal. In view of these facts, which I believe can be verified by anyone who has the patience to repeat these experiments, the following quotation from one of the most prominent authorities in dental histology seems hardly justified: "Lymphatic vessels in the dental pulp exist only in the minds of some incompetent observers." It does not seem possible for this fluid to pass from the dental pulp through delicate sharply walled channels to the lymphatic spaces of the submaxillary lymph glands by any means except that of lymphatic vessels. If these are not lymphatics, what are they? I only know what was found in these experiments. While this work on the lymphatics was going on, Dr. Dewey, acting under my direction, collected material and clinical histories from twenty-two or twenty-three cases in which necropsy had been performed in the county hospital. From the study of this material, I became convinced that in chronic recurrent infection of the peridental membrane, the infection progresses along the lines of the lymphatic vessel

or in the areas where they would naturally be expected to be found. This led to a careful restudy of all the research material on the lymphatics with reference to the course and distribution of the lymphatic vessels in the peridental membrane and gingivae.

This article on the lymphatics was published in October, 1913.[3] In regard to this pathologic material, since it contained, as I have said, so many things I could neither understand nor explain, I was convinced that the pathology of the peridental membrane was by no means a simple problem. Such a hodgepodge of material collected more or less at random presented a mixture of pathologic pictures, from which it was impossible to separate the individuals; and from it all, I was able to make out but one thing clearly, namely, the relation of the progress of recurrent chronic infection in the tissues to the course of the lymphatic vessels.

From the comparison of this lymphatic material with pathologic material, it is apparent that (1) the first reaction of the tissue to the invading infection is found in the interfibrous tissue of black in which the lymphatic vessels are located; (2) these spaces between the principal fibers become filled with inflamatory exudate and cells and largely increased in size; (3) the principal fibers are pushed aside, the pressure causing degeneration of their cellular elements, and, finally, necrosis, so that the principal fibers are broken and the adjoining interfibrous spaces united, forming large areas filled with inflammatory tissue; (4) in this process, the fibers covering the cementum are the last to disappear. In this respect, progressive infections originating in the gingival space are similar in their reaction to infection reaching the peridental membrane through the apical foramina; (5) the direction of the progress of infection and the character of the lesion produced is determined by the direction of the lymphatic drainage. In the infection of the labial and lingual surfaces of the gingivae, due to the irritation of salivary capillaries and the harboring of infectious micro-organisms, the lymphatic calculus draining the connective-tissue papillae of the labial and lingual surfaces of the gingivae extend down the outside of the alveolar process, and the inflammatory process follows the same direction. There is destruction of the bone under the periosteum, and recession of the bone of the alveolar process, but the tissue between the bone and the cementum remains normal in character and appearance and shows no indication of infection. In contrast to this, infections arising in the gingival space, which may or may not be associated with small deposits of calculus in that region, follow the lymphatic capillaries from the connecting-tissue papillae under the epithelium lining the gingival space which proceed toward the apex, passing through the fibers of the ligamentum circulare; and, between the bone and the cementum in the peridental membrane, there is inflammatory reaction, beginning in the interfibrous spaces and proceeding in the way previously described. There is destruction of bone on the peridental membrane side of the alveolar process, and formation of new bone on the periosteal side, leading to eversion of the occlusal border of the alveolar process, and the formation of a conical space filled with inflammatory tissue.

3. Noyes, F. B.: J.A.M.A., 71: 1179-1184 (Oct. 12) 1913.

CONCLUSION

The principal object in presenting this paper, as I have said, is the hope of stimulating someone to continue work in this direction. It is six or eight years since this work was published, but as far as I have been able to follow the literature, there has been no additional work in this direction, and the work has not been confirmed by other investigators. The work to be done in this field has hardly been started. For instance, the only teeth the direction of whose lymphatic drainage has been studied experimentally are the upper and lower canine and first molars and these have not been separated as, in all animals experimented on, all four teeth on one side, and some times on both sides, were injected. At the time, it was considered that since there were so many chances for failure of the fluid to get through the apical foramen, we should use at least that many opportunities, and that the first thing to be demonstrated was the course of the vessels in general. Lymphatic vessels emerging from the inferior dental canal at the mental foramen and the infra-orbital foramen were followed to the first cervical glands of the neck. It seems probable that lymphatic vessels also pass through these canals to their proximal as well as their distal openings, but no attempt has been made to follow such vessels, for instance to the glands of the deep cervical chain. It is true that there has been some indication of the injecting mass reaching these glands.

This field is difficult and requires patience, but work in it is by no means impossible.

SOME BASIC FACTS GROWING OUT OF THE DUAL INDIVIDUALITY OF THE HUMAN DENTURE, AND THEIR RELATION TO SUCCESS AND FAILURE IN ORAL RESTORATIONS*

By JAMES KENDALL BURGESS, D.D.S., New York City

ON the cover of the *Dental Cosmos* for many years have appeared these words: Observe, Compare, Reflect, Record. There is appalling evidence that the rank and file of those who essay the work of oral restoration have not taken this counsel to heart nor profited greatly by its precepts.

Here are some, at least, of the rungs of the ladder of progress, and if one may base his judgments on observation of the conglomeration of so-called restorative efforts, from the simple filling and gold inlay on through the procession of crowns of all types, bridges, partial removable dentures of every style and extent, and full dentures with bases of all the materials used in their construction, that present distorted forms under the eyes of every scrutinizing practitioner, one must be forced to the conclusion that the perpetrators of these monstrosities, instead of climbing the ladder, have walked under it; and that the misfortunes supposed to follow this ominous procedure have been visited on the luckless patients.

Passing in review are seen: ill-contrived and poorly executed devices of every character and every material used in the oral cavity; violation of every structural principle; neglect of every requirement for efficiency and durability, and the outrage of every prophylactic precaution and necessity; esthetic considerations needlessly sacrificed to the purely mechanical; the crowns of abutment teeth mutilated or entirely destroyed; pulps butchered to make a tinker's holiday; the gingival tissues injured by the invasion of ill-fitting devices, and the supporting bone brought to ruin; degeneration, disorganization, devastation, desolation. A morbid and cheerless picture, but one to be seen in some stage of its progress, and often as the finished product, in the office of any dental practitioner and at almost any hour devoted to examination and consultation. Dr. Hunter's familiar indictment of this type of dentistry is as apropos today as it was in 1910. But Dr. Hunter, looking through the eyes of the physician, did not see it all. One is forced to ask—almost to wail—"Why should these things be?" Time was when the legitimate excuse was made that oral restoration by means of bridgework was in its infancy, that time had not sufficed to

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work out its problems. But this plea is no longer tenable. Bridgework has long ago passed out of its infancy, and many of its problems have been solved. It comprises an important specialty of a profession, far advanced in its development, and scientifically taught to its students; and, in its highest development, it has kept pace with the rest and the best of that profession. The cause for discouragement is that so many of those who should have its interests at heart have not kept track of that development nor appropriated its benefits.

In any consideration of scientific progress and those engaged in its advancement, there are several classes that must be left out of consideration as incubuses on the body professional. They are responsible for much of the havoc earlier described, and they create the problems that those who follow their devastating trail must solve. Among these are the standpatter to whom dentistry was a finished profession when he went to college; the tired business man type, to whom any problem is anathema—he drifts with the tide with never a stroke; shell crowns for anterior and posterior teeth, and God help the middle; the commercially minded; the charlatan and many more, including the man who is not blind but just doesn't care.

But leaving out all of these and their waste products, there still remains in the productions of the more honestly intentioned much evidence of a lack of full comprehension of the problems involved in oral restoration. The cause of this state of affairs, I believe, lies purely in the realm of mechanics, resolving itself into a serious engineering problem. We have studied and mastered, at least reasonably, the mechanical procedures involved in producing our restorations, in both operating and laboratory departments; and we have studied matters that relate to the status of the denture as a vital organ: histology, anatomy, physiology and pathology. But we have not given sufficient weight nor study to the status of the denture itself in its other individuality as a mechanical entity, nor to the problems growing out of its unity and solidarity as they effect our efforts toward conservation or restoration. Evidence of this may be found in many mouths where, even with workmanship above reproach, a certain incoherence of plan on which the operations have been conducted reveals unmistakably that their producers thought and worked in terms of teeth rather than of dentures. The human denture is not merely teeth; and especially not merely a collection of individual teeth, to be dealt with as such. The teeth, to be sure, are the service units for the support of which and their functioning the entire denture is constructed; but the individual teeth are but units in a highly organized, closely related, composite piece of mechanism, and who deals with the denture on any other basis fails in a great responsibility. It is a great engineering achievement on Nature's part, and its reconstruction, once it is disorganized, must, to fulfil its highest mission, comprise restoration in its truest sense as far as the circumstances of the individual case will admit. That is to say, it must comprehend the denture as one composite whole, to be dealt with, not piecemeal, but as a unit, with the individual teeth as mere component parts, by reorganizing it through replacement of its lost parts, reestablishing its conformations and relations and thus retrieving its status of unity and solidarity. Until

we have digested and assimilated these vital facts, so that they become part and parcel of our professional being, we shall be thinking always in terms of teeth instead of dentures, always merely fixing teeth and never restoring dentures.

The very degree under which we conduct our professional activities lends itself to a false psychology. We call ourselves doctors of dental surgery. The word "dental," referring to teeth, is a relic of an earlier day, with its simpler ideals. But with increased knowledge and larger vision, we should establish our ideals upon broader and firmer foundations and devise a sturdier terminology to meet its demands. If we insist on "doctor" and "surgery," then we should be doctors of dentural surgery. But whatever we may call ourselves, unless we possess or acquire the knowledge, facility and mental attitude that will constitute us dentural engineers—or oral engineers as you will—we shall not possess the equipment for oral restorations.

One who thinks merely in terms of teeth will have his ideas and ambitions circumscribed within that narrow horizon. To one who has gained a broader vision, who thinks in terms of the denture in its essential significance, the replacement of teeth is but one factor of a comprehensive program which will produce results in restoration of which the replacement of lost units is by all odds the simplest and most easily accomplished factor.

What, then, are the elements of this comprehensive program and on what fundamental facts must it be based? Our first requirement is to know the denture—to be sure of its histology, its anatomy, its physiology. But this is not enough: not to disparage this other individuality of the denture as a living organ with its vital component factors, but simply to lay them aside for the moment, we must comprehend it, apart from every other consideration, as a mechanical entity, disconnected and distinct from the organism, a wonderfully and beautifully constructed piece of mechanism, the finished product complete in itself and fresh from the hands of Nature. As the denture stands thus, unimpaired and ready for service, it is necessary to know it from its inverted maxillary base through every detail of its mechanical organization and construction to the mandibular lever, inclusive. The denture divides, naturally, into upper and lower halves, which meet at the plane of the occlusal surfaces. For a better understanding of the mechanics of its construction, each of these halves should be considered in two sections according to the respective parts they play in its activities: (1) what might be characterized as the upper and lower service arch, comprising the orderly alinement and arrangement according to function of the service units or teeth, these service arches, considered together and related, constituting the service equipment, and (2) the foundation or supporting mechanism, into which the units comprising the service arch are anchored. Here, we have a sharp differentiation between the section of the denture actually producing the service and the section that furnishes the support, makes the service possible and bears the burden of its reaction.

A more detailed analysis, not possible here, will reveal outstanding mechanical features of the construction, as they pertain, respectively, to the individual

teeth, the service arches, the combined service arches or the service equipment, the respective foundations—upper and lower—and the relations of the service equipment to the foundations.

Thus, the denture at rest. In operation, it is important to know the strength of power inherent in the motivating equipment of the individual case, the measure of force it applies in the performance of service, the various directions in which the force is applied, the degree of stress generated in its application, the relation of this stress, which passes on to the foundation as pressure or leverage according to the direction in which it is exerted, to the resistance inherent in the given foundation, determinable by the character and quality of its structural materials and the proportionate depth of anchorage of the service units in them, and the influence of this stress upon the foundation.

Here we have, in outline, the normal denture in its mechanical aspect, and these are details of imperative information if we would approach intelligently the task of reconstructing and restoring the disorganized denture.

If one comprehends these factors of the human denture and their significance, it must be apparent that here is one complex organization of many parts and multiple relations, all fashioned and coordinated for playing each its own particular part in a general scheme of service and mutual protection; and that, as no part can act or serve alone, so no part and no factor may be considered as of itself or dealt with as an individual, but always as part of the whole and in its relation to the whole. And especially it must be noted that, in the two primary divisions of this complex organization into foundation and service equipment, the entire anchorage scheme and mechanism of the foundation are contrived to furnish the ultimate of support to the service equipment during activity, with a minimum of consequent wear on the units of the service equipment and a minimum cost to itself in reaction from such activity, and that the whole design of the service equipment, in conformation, arrangement and relation, is intended to produce a maximum of service with a minimum expenditure in attrition on its units and a minimum tax on its supporting structures.

When the denture becomes disorganized, it is the relation of these two divisions that becomes of paramount concern. The determining factor in their relation is the status of the foundation itself; and of vital concern to this status is the character of structural materials of which the foundation is composed. At this point, the status of the denture as a vital organ becomes indissolubly related with its status as an organized piece of mechanism, and here enters the second qualification for oral restoration: surgical knowledge of the structural materials comprised in the denture—their several characters, their conformations and relations, their maintenance, their function; every influence inimical to their welfare; the disturbances which eventuate through these influences; how to guard against these influences, and how to overcome the effects of their disturbances and ward off their recurrence.

In our efforts at reorganization, we may be said to have one constant and numerous variable factors with which to deal, the constant being the status of the foundation, the consequent measure of support of which it is capable and

the degree of resistance inherent in it. Once the foundation has degenerated below the normal, it never again can attain the normal, however near it may approach it, and the measure of such approach will determine the measure of support it can afford the service arches.

In our efforts in behalf of the foundation, it is possible to restore its subnormal structural tissues to normal vitality and thus add the margin of strength made available through their improved tone and firmness, but since we cannot add to normal vitality nor create and add vital tissues to the supporting structures, it is obvious that this restoration to normal health and tone marks the limit of our ability to increase their supporting power.

Being unable to aid Nature beyond this point through the medium of the foundation which I have described as the constant factor, we must have recourse to the variable factors which are to be found in the service equipment.

Every service unit or tooth is a lever with its fulcrum, in the normal denture, at the cervix. The denture in operation generates stress against these units, which is delivered in the nature of leverage against the retentive walls in the foundation; and this leverage demands a resistance which, to be effective, must maintain a definite ratio to the leverage. In the disorganized denture, the supporting structures are frequently altered through waste; the fulcrum is thus moved back from its normal position; leverage is increased, resistance decreased, and the ratio of the resistance to the leverage progressively decreased; and, since we cannot raise this ratio or even check its retrogression, once it is reduced beyond a certain limit, by increasing the foundation resistance, it is obvious that if it is to be raised at all, it must be through the reduction of leverage against the foundation. In the disorganization which the denture undergoes, the occlusal surfaces of the unit frequently are altered, and often beyond recognition, by some one agency or a combination of many destructive agencies that prey upon them. The continuity of the individual arches frequently is lost through extraction or migration or alteration of the unit. Thus the individual units, because of anchorage reduction and surface alteration that increase their burden, and render them more in need of mutual support, lose their community interest and are left to shift for themselves as individuals, and the normal relations of the occlusal planes are completely incoordinated. Thus Nature's carefully worked out engineering scheme of conformation, relation and coordination has gone into the discard.

This also is an unpleasant picture that may be seen, in some stage of its progress, with distressing frequency. Fortunately, here is a more productive and gratifying field of effort: the opportunity for retracing, in some measure, at least, the steps through which the disorganization has progressed, correcting or eliminating some of the influences that caused or abetted it, and thus retrieving a worth-while part of the lost ground.

Here is demanded the third qualification of those attempting oral restoration: what I prefer to characterize as an engineering sense. These procedures are on a scale too small to admit of mathematical calculations, and logarithms and blue prints are not necessary to the scheme; but one must possess an instinctive feeling for values in all

matters pertaining to stress and resistance, which are fundamental factors in the operations of the denture, and for all the elements of its construction related to these fundamental factors. Broadly stated, there are three procedures important to such a program of denture reorganization: (1) to reestablish the continuity of the individual service arches; (2) to recondition their occlusal surfaces, and (3) to coordinate their occlusal planes.

By these means, the efficiency of the service equipment is increased through its reconstruction and the reestablishment of the conformations and relations of its occlusal surfaces, with a reduction as well in the stress generated at the occlusal planes and delivered as leverage through the units to the foundation. The service units themselves are stabilized through mutual contact and support or mechanical device, limiting their range of movement under stress and reducing the leverage against the supporting socket walls. Thus, where we were powerless to increase the ratio between resistance and stress by increasing the degree of resistance in the foundation, we have been able to accomplish this by reducing the measure of stress delivered to the foundation.

If time and occasion permitted, we should consider, at this point, the fourth qualification for oral restoration: the mechanical skill necessary for the work of execution by means of which the comprehensive program is given vital expression; but to enter on a discussion of bridgework, stabilizing devices, partial removable dentures and what not, to thresh out the multiplicity of ideas extant or even the principles on which they are based and winnow the wheat from the chaff, would be another story and require another essay—perhaps many. The thought I desire to leave is this: The human denture possesses a dual individuality: it is a vital organ and a mechanical apparatus. Mechanical disorganization reacts to the degeneration of the vital organ; and when it comes to us disorganized and degenerated, our several opportunities and abilities to render aid to either of these individualities through the medium of its vital aspect are within very narrow limits. Our most important and profitable avenue of approach lies through the mechanical, by which, with a better comprehension of its problems and intelligent effort in behalf of the denture, as one composite whole, we may go far toward the restoration of its mechanical aspect, thus establishing a prophylactic influence over its vital aspect and so fostering reorganization and conservation of its integrity.

DISCUSSION

Ellison Hillyer, Brooklyn, N. Y.: During the last quarter of a century, we have seen marvelous changes in the realm of crown and bridge work. There has been brought about advancement the equal of that in any other branch of the dental art. That much work was done by the unskilful and the unscrupulous is admitted, but comparisons of methods should never be influenced by these cases. The pendulum of progress in many fields of dental investigation has swung from extreme to extreme, and crown and bridge work is no exception. The general trend in all directions is toward the broad midground of application of the best method for each individual case, irrespective of any definite system. No two cases are exactly alike. While general principles will govern our actions, both in diagnosis and operation, each case stands alone in its specific treatment. We have cause to be highly optimistic regarding the future. Never has so much thought and care been expended for the benefit of the patient. Methods will come and methods will go, but the best of each will be retained, for the advantage of both patient and operator.

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Editorial

THE CURSE OF COMMISSIONS

The professions assume to have a higher standard of ethics than obtains in ordinary business. It has been the pride of professional men and women that the public expects them to conduct the affairs of their calling in a different manner from that of those who sell goods over a counter or who barter in commodities. The intimate relationship of a professional man with the people he serves places on him an obligation of a more exalted character than if he were engaged in any of the commercial pursuits. Certain customs which may be considered legitimate in the business world become pernicious when practiced in the professions.

One of the most outstanding of these is the paying or receiving of commissions on referred patients. This evil at one time threatened to assume the proportions of a hydra-headed monster, and even yet it reaches out its tentacles occasionally and calls for suppression. Recently, the Executive Committee of the Massachusetts State Dental Society called attention in their *Bulletin* to the fact that a certain x-ray dental laboratory had sent a notice to

the profession of Massachusetts frankly offering to split fees. As the Committee remarks, it is not a question of the laboratory (which "can sell oil-heaters if it so chooses,"), but of the profession. No dentist can pay or receive commissions and retain his membership in the American Dental Association. At the 1922 meeting, in Los Angeles, a code of ethics was adopted by the House of Delegates which contained a clause making it a violation to pay or receive commissions, and as far back as 1909, a similar code was adopted by the Illinois State Dental Society. The Editor of THE JOURNAL is grateful for the fact that it was his privilege to assist in putting through this provision in both of these organizations.

The whole idea of split fees is wrong in principle and vicious in practice. It is a downright imposition on the patient, and whatever imposes on the patient demoralizes the profession. The practice had its inception in the advent of specialization. When men began to specialize, they naturally considered means by which the general practitioner might be induced to refer patients to them; and arguing, as is the custom of the age, that "money talks," they hit on the plan of paying commissions. It is probably true that some of these men did not realize the iniquity of what they were doing; but that the practice was iniquitous, there can be no question.

The incentives which impel the general practitioner to refer a patient to a specialist are usually such as to place the general practitioner under an obligation to the specialist, instead of the reverse. He refers the patient because he realizes that there is a certain service which the specialist can perform more skilfully than he; in fact, there is some service for which he is not qualified or prepared, and in which he would fail if he attempted it. Then there is other service which is particularly distasteful to him, and it is a relief to him to be rid of it. In either of these cases, it is an accommodation to him to have the specialist relieve him of a situation which is irksome. Then why should he accept tribute from the specialist who has done him this favor?

The only way a commission can be paid is through injustice

to the patient, or the specialist, or to both. If the specialist charges the patient only what the service is worth, it is an imposition on him to be obliged to turn over part of his fee to some one else, and if he charges more than the service is worth so that he may thereby divide with another, he is working a gross injustice on the patient. In any possible consideration of this subject, there is no equitable basis for the practice of paying or receiving commissions, and no true professional man will ever countenance such a pernicious procedure.

If the professions are to maintain the high regard in which they are held by the public, it will be only through the medium of an exalted conception of their obligation to humanity and the most punctilious observance of ethics in all its bearing on their relationship with the people they serve. Anything which smacks of deception, or which takes advantage of the ignorance of the patient, is demoralizing and baneful, and of all the so-called minor vices of professional life, the worst is that of fee-splitting. Aside from the fact that it is a direct violation of the established code of ethics, it is so despicably mean and underhanded that a man immediately sinks beneath the pale of respectability when he practices it. Let us banish this evil forever from our ranks, so that as a profession we may look the world in the face and not be obliged to blush for our misdeeds. Every argument possible in favor of fee-splitting is as nothing compared with all the things that can be said against it, and the campaign for its suppression should not cease till its name is known as anathema from one end of the land to the other.

STATE MEETINGS

Most of our state societies will convene in the next few months, and the promise is good for some very successful meetings. But every meeting now being planned may be made better by concerted action on the part of the officers. Meetings that are permitted to just jog along on the same old plan year after year

seldom record any definite advance. Programs that were good for 1926 may not be sufficient for 1927. The greatest menace to any state organization is dry rot, and this disease attacks a dental society very quickly unless something is constantly being done to infuse new life and energy in it. There are two things needful for maintaining the interest in a society: an awakening on the part of the old members, and the acquisition of a constantly increasing new membership. The infusion of fresh blood is one of the chief essentials in sustaining the energy needful for dental society work, and no organization can function to its fullest possibilities without it.

In every society, professional or otherwise, a periodical checking up is necessary in order to get an intelligent idea as to whether or not real progress is being made. No enterprise of life can ever stand still—it must either advance or recede, and sometimes a society is going back without the officers or members being aware of it.

One of the things that most intimately concern the American Dental Association in its relation to the state societies is the appointment of delegates. Every state organization has the privilege of appointing its pro rata number of delegates to represent it at the annual meeting of the American Dental Association; and the House of Delegates thus made up transacts the business of the parent body. It will thus be seen how very essential it is that none but good men be appointed to this important position. The business of this Association is becoming so extensive, and its interests are so varied, that it requires men of calm judgment and discrimination to sit in the House of Delegates and act intelligently on the different problems which arise. No man should be appointed a delegate simply because he is a good fellow. Good fellowship is a delightful thing to contemplate, and it is needed in every organization, but there is something more important even than that as a qualification for service in the House of Delegates. Honesty of purpose, firmness of decision, far-seeing judgment and amenableness to reason are qualities more desirable even than being a good fellow, and every

state society should exercise the greatest care in the selection of its delegates and send only men of character, who will do credit to the component society and render efficient service to the American Dental Association. Another requisite of an ideal member of the House of Delegates is a previous experience, if possible, in organization work. A man who has served in his state or local society and has thus become familiar with the machinery of such bodies is more valuable than one who has had no experience in this work.

YOUR OWN DESTINY

For the benefit of every young man and woman studying dentistry today, we would like to call attention to the patent fact that in their own hands they hold their destiny. This is something worth thinking about, and it is something which the average student seldom seems to consider. To know absolutely that one carves one's own career is a really inspiring thought. If this conviction could be instilled into the consciousness of every student, there would be fewer failures in college, and if it could be carried out into the affairs of life after graduation, there would be more men and women of real distinction in the practice of dentistry.

The great bane of humanity is lack of self-reliance and responsibility. To hold one's self to strict accountability for every act is the greatest discipline of life, and no man can establish the basis of real character without doing this. The habit of falling back on some outside cause when failure of any kind occurs is debilitating in the extreme, and in the end it tends to lack of moral fiber.

Every dental student should look each problem fairly in the face and accept the theory that it is his problem and that the solution lies in his hands—not in the hands of someone else. If he does this, he will develop; if he does not, he will degenerate.

DEPARTMENT OF DENTAL HEALTH EDUCATION

DENTAL HEALTH EDUCATION FOR THE PATIENT*

By GILLETTE HAYDEN, D.D.S., Columbus, Ohio

THE more awakened the dental profession becomes to the pressing need for the prevention of dental diseases, the more apparent grows its own need for adequate training in the basic medical sciences, in individual hygiene, in food values and nutrition, and its need for research into the causes of dental health.

The study of dental disease has been so intriguing, and the demand for the correction and repair of dental defects so compelling, that we have been almost too occupied as a profession with the thought that our sole function was to repair teeth, remove and replace them.

Happily for us, and for those who look to us for guidance in dental matters, astute observers and research workers have been pointing out constantly and for years, the truth that dentistry cannot be practiced without due consideration of the rest of the body; and that the interrelationship of the mouth and all other body parts must be reckoned with in dental health, dental disease and dental treatment.

We are rapidly coming to the realization that the practice of our mechanical and artistic skill is but an attempt on our part to compensate for the dental defects accruing from our civilized mode of life. We have discovered that remedial methods alone are unequal to the requirements for the preservation of the dental tissues, and the conviction is growing that the prevention of abnormal conditions in the mouth is an imperative need; for in prevention lies our only hope for the control of dental degeneracy in the coming generations and the limitation of dental disease in the present one.

We are finding out that dental health is inseparable from general health and that the practice of the rules of hygiene is as applicable and essential to the health of the mouth as to the vigor and well-being of every other part of the body. ". . . the teeth are not an isolated mechanism with the sole function of grinding food—*not* removable and replaceable like pegs in a cribbage board—but a vital and integral part of the bodily economy which cannot in its turn function independently of them . . ."[1]

*Read before the Ohio State Dental Society, Columbus, Ohio, Dec. 7, 1926.

1. Owre, Alfred: Prunes or Pancakes. Minneapolis, University of Minnesota Press, 1926; p. 89.

The dental profession today, in co-operation with other professions interested in human health and welfare, is called on to use its knowledge and apply its skill so that people may live under modern civilized conditions without reaping the ill-effects on the dental mechanism which now accompany this mode of living. This demand on dentistry requires that the preventive aspect of our calling be developed more fully and be applied more universally.

Though we are, perhaps, far from being well equipped to meet the fast-growing demands of our patients for the prevention of dental diseases and abnormalities, we are in possession of some old and some new knowledge which, if it were effectively applied, would materially reduce cavity formation, periodontal disease and malocclusion.

The work of the dentist is twofold. It is both educational and remedial, and the dentist should be both teacher and operator, for he has as much of a duty to perform as an educator as he has as an operator. The dental patient has a right to expect all the service that the dentist can and should give, because his ability as a teacher is reflected in the health of the mouths of his patients as definitely as is his operative skill.

The educational phase of dental service has received added and needed recognition through the establishment of the Department of Dental Health Education by the American Dental Association, and the far-reaching effects of the dental educational material presented to the profession through this department can scarcely be estimated.

A question confronting dental practitioners seems to be: "To what extent is the dentist privileged to teach dental health to his patients?" The answer must necessarily be: "To the extent of his own equipment for such teaching." In the light of our present-day knowledge, dental health cannot be taught independently of general health; consequently, the dentist must be trained to meet the demands laid on him as a dental health educator.

It has already been stated that the rules of hygiene are as essential to dental health as to general health, so that a knowledge of hygiene should not only be acquired by the dentist, but should also be passed on by him to his patients.

Fisher and Fisk, in their book entitled, "How to Live," list sixteen rules of hygiene, classified under four main heads, namely, "Air, Food, Poisons and Activity." These rules are quoted because their simplicity and completeness make them especially valuable in the health education of the patient.

THE SIXTEEN RULES OF HYGIENE

I. Air
   1. Ventilate every room you occupy.
   2. Wear light, loose, and porous clothes.
   3. Seek out-of-door occupations and recreation.
   4. Sleep out-of-doors if you can.

II. Food
   5. Avoid overeating and overweight.
   6. Avoid excess of high protein foods, such as meat, flesh foods, eggs; also excess of salt and highly seasoned foods.
   7. Eat some hard, some bulky, some raw foods daily.
   8. Eat slowly and *taste* your food.
   9. Use sufficient water internally and externally.

III. Poisons

10. Secure thorough intestinal elimination daily.
11. Stand, sit, and walk erect.
12. Do not allow poisons and infections to enter the body.
13. Keep the teeth, gums, and tongue clean.

IV. Activity

14. Work, play, rest, and sleep in moderation.
15. Breathe deeply; take deep-breathing exercises several times a day.
16. Keep serene and whole-hearted.

Great and permanent results require the adoption of an all-round, well balanced health regime beginning in childhood and continued throughout life.

Moderation and regularity in the practice of these rules is the keynote to their greatest effectiveness.

The results of the research and studies of such workers as E. V. McCollum and Percy R. Howe on the subjects of optimal nutrition, and the effects of diet deficiencies as related to the teeth and their investing tissues, are of such a nature that it is becoming more and more evident that the prevention of dental defects in the future will be founded, very largely, upon the practical application of a thorough knowledge of food and nutrition. Dr. McCollum says:

Prenatal life, infancy and early childhood are the critical periods. The greatest good is to come to the next generation, as far as educational effort can accomplish its purpose, through the solicitude of mothers and fathers in so caring for their unborn and born children as to obviate the establishment of those physical defects which not only prevent normal muscular development but which affect the entire outlook upon life.

Malnutrition is usually the primary cause of physical inferiority in childhood. Malnutrition is not, as many have hitherto believed, ordinarily the secondary result of those physical defects which the clinic seeks to remedy, but it is the primary cause from which these physical defects generally arise. Furthermore, the present widespread view that the most important task in hand is the medical treatment of those children in whom clinically discernible defects exist is a mistaken one. First in importance both from the standpoint of the physically defective child and of the national welfare, is the establishment of nutritive conditions which are regulated as nearly as possible with the scientific precision necessary to insure optimal well-being. The clinic should occupy second place in the scheme of human betterment.

The basis of preventive dentistry is satisfactory nutrition during development.[2]

Optimal conditions of nutrition during the time when the teeth are forming (before birth and in childhood) will go far toward insuring that the tooth structure will be excellent. It is during these periods that the nutrition of the mother and child are of the greatest significance from the dental standpoint. It is also of great importance for the preservation of the teeth that a state of good general health be maintained and especially that the digestive tract, of which the teeth form a part, be kept in an hygienic condition.[3]

"The welfare of the family is largely in the hands of the one who provides the 'Three Meals a Day,'" states Mary Swartz Rose in "Feeding the Family." The education of this provider of meals in matters of diet is important, and the dentist has many opportunities to be of help to her in her problem of proper food selection and preparation for the dental health of her family.

The dentist, as a health educator in the dental field, must necessarily acquaint himself with the findings of the nutrition experts, particularly as they

2. McCollum, E. V.: The Newer Knowledge of Nutrition, New York, The MacMillan Company, Ed. 2; p. 430-431.

3. Footnote 2, p. 92.

relate to dental health and disease, and be prepared to inform his patients as to what has been discovered in recent years concerning foods and nutrition and to urge them to read one or more of the books on the food requirements for health that are now available. A readiness to give this general information to dental patients is most desirable. It is, of course, recognized that there are many dental patients who should be advised to seek the services of their physician for special instructions as to an individual diet.

It has always been within the province of the dentist to give information on the subjects of the development, structure, function and care of the teeth and their investing tissues, together with the diseases to which they are subject, and the repairs, removals, replacements and treatment that dentistry affords. The education of the patient by the dentist in these matters is of great benefit, for, with added knowledge, comes increased appreciation of the dental equipment and its relationship to the health of the entire body. Of special use to the patient striving to maintain the health of the dental tissues is a knowledge of the importance of use of the teeth in the mastication of food, of the value of the exercise produced by chewing coarse, hard foods, and of the daily care of the mouth. It is also of use to them to know what safeguards dentistry is offering as aids in the establishment and maintenance of mouth health, and to be informed as to what constitutes good dentistry.

The establishment, in the offices of dentists, of a loan library that contains books and pamphlets whose subject matter relates to general and oral health will be found of great help in rendering educational dental health service. These books are lent to patients who are coming to the office for dental services. Certain pamphlets from the large list now available may be given to the patient. For several years, I have been utilizing a small collection of books and pamphlets in the education of patients, and I have found that this method of increasing the interest, enlightenment and cooperation of the patient has been valuable.

A group of books for adult and one for the child are needed. The Department of Dental Health Education of the American Dental Association has prepared a very useful pamphlet giving such a list.

Submitted with this paper are several leaflets containing information in a form which has been found useful in the dental health education of patients. Other material is also presented as an exhibit to further demonstrate the loan library idea.

The only reason for presenting this subject is to emphasize its importance in the practice of modern dentistry, and to indicate one way in which the dentist may be aided in carrying out some of the educational features of his services.

Every effort to strengthen and reinforce the defensive mechanism of the body is a step toward the prevention of diseases. Only by helping our patients and the general public to institute for themselves the practice of a daily regime of living which is in accordance with our best knowledge of the essentials for positive health can we hope to meet the real problems of prevention of the dental defects that confront us as workers in the profession of dentistry.

THE TRAINING OF THE DENTAL HYGIENIST*

By HAROLD J. LEONARD, D.D.S., B.A., Milwaukee, Wisconsin

IN the years from 1910 to 1915, it was proved to the dental profession that a large amount of systemic disease and ill health was due to infections in and about the teeth which it was the business of dentistry to prevent and to treat. When this appalling situation was borne home, the profession awoke to the fact that, as organized, it was unable to keep up with the repair of the ravages of dental disease in any but a minority of the population, to say nothing of getting ahead of these conditions by a preventive program. It was estimated that all the dentists in the United States could not keep ahead by repair of the dental defects in the children of New York City alone, if they were all assigned to the task. Even supposing there were a sufficient number of dentists, the majority of persons would be financially unable to afford efficient repair work. This fact put a check to the effort to solve the problem simply by increasing the output of graduates from the colleges. Many surveys show but few places in the United States where the demands for dental work cannot be supplied.

In 1898, D. D. Smith of Philadelphia demonstrated that dental disease, that is, dental caries and periodontoclasia, could be prevented almost completely by frequent polishing of the teeth. A monthly polishing or prophylactic treatment, which, it was shown by M. L. Rhein, could be given by a technician trained in the office, proved most useful in maintaining the health of mouth and teeth. Many leaders took up this idea of the monthly prophylactic treatment and, by 1915, many dentists had women assistants trained to do this work in their offices. In 1915, Dr. Fones developed the idea to the point of training a group of such prophylactic technicians to do this work for the school children of Bridgeport, Conn., this being the first start toward a comprehensive preventive dentistry program for any community.

The ten years since this occurred have seen the idea spread until now twenty-six states, including Hawaii, have laws licensing dental hygienists, and there are eleven training schools for educating them. The movement has grown in spite of determined opposition on the part of many dentists who feared any change in the law or custom which might let down the bars to dental practice or might conceivably take work now needed by dental practitioners. Not only was there initial opposition: the hygienists have, several of them, created opposition by acts and practices contrary to the spirit of professional ethics. There is still debate about them, therefore, and it seems wise to study the effect of their ten years of existence in mistakes, trend and accomplishments.

Have the dental hygienists proved themselves the correct answer to the need for preventive dentistry? What is their field and how should they be trained to meet the needs? What difficulties have they caused and how should these be met?

*Read before the Section on Mouth Hygiene, Preventive Dentistry and Public Health at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 26, 1926.

The answer to the first question can be given in the affirmative in part only. The hygienists have proved themselves an invaluable factor in many places in reducing markedly the incidence of dental disease in school children, at a comparatively small expense. In other places, the expense has been heavy and the results are less gratifying. The difficulty lies in the fact that those directing preventive dentistry programs, like the rest of us, do not themselves know some of the causes of dental disease or how to prevent it. It is, therefore, manifestly impossible for these dentists to direct a campaign for preventive dentistry very effectively by means of dental hygienists or any one else. As they are influenced by one or another of the current theories regarding the fundamental cause for the prevalence of dental caries so they direct the hygienists under them in preventive measures. The results in many cases are bound to be largely a failure.

But there are certain facts apparently well established that can be used as a basis for work.

1. It is known that correct daily cleaning of the teeth and massage of the gingiva is an almost sure preventive of gingivitis and dental periclasia. It is known that it reduces bad breath, helps to minimize the spread of contagious disease, improves the health and reduces, to a large extent, the decay of the teeth. By modern methods of home care, this result can be attained by the individual himself with very little treatment by the dentist or dental hygienist.

2. It is known that the average American or English dietary predisposes greatly toward dental decay as contrasted to that of Italian peasants or semisavage Malays, for example. Just what the exact faults in the English-American dietaries are, and why they cause dental caries, are a matter of controversy, but there seems comparative unanimity of expert opinion that a diet nearly exculsively starch and sugar products, muscle meat, tea and coffee, with a minimum of fresh leafy vegetables, fresh fruits, whole grain cereals and milk, tends greatly to lowered resistance, physical defects, general disability and particularly dental caries. Especially, the continuous use of candy and preserves tends, in children, to excessive dental decay.

3. It is known that efficient mastication, that is, sufficiently prolonged and effective chewing of food, helps to develop the jaws, keeps the teeth clean and benefits digestion and general health greatly. Those working along this line can show that communities in which the children are educated to efficient mastication show a great decrease in dental decay.

4. It is known that general health conditions have a profound effect on the teeth. Physical defects such as diseased tonsils and adenoids, faults in hygiene of almost every type, and systemic disease all predispose strongly to disease of both the dental and the periodontal tissues. The fight to prevent dental disease must therefore overlap that against other diseases. To combat it successfully, the worker must have a knowledge of hygiene and be able to recognize physical defects needing correction and to appreciate and meet the difficulties which many social environments place in the way of health.

5. In spite of all efforts at prevention cavities, will develop to some extent in the teeth of children, and these must be taken care of. The fact that there must be some reparative and surgical work has to be considered in studying

the dental hygienist as a factor in a preventive dentistry program.

It will be noted that, except for the fifth, all of these preventive dentistry means are educational. And even the last is largely so, because most children must be taught to have the reparative and surgical work done. Children and many adults must be taught to keep the teeth clean and the gingivae massaged. They must be taught what kind of food to eat and what to avoid. They must be taught to chew effectively. They must be taught how to live so as to be healthy. Physical defects and systemic disease that predispose to dental disease must be recognized, and children and parents must be induced to correct them. Dental defects must be discovered early, and children and parents must be taught to have them corrected. The proper valuation of the teeth is a thing that can be taught, and it is as easy to create the desire to keep the teeth healthy and beautiful and to have defects corrected as it is to create fear of the dentist.

Analyzed thus, it becomes clear that the great need is not for prophylactic technicians but rather for educational workers who are trained in handling and teaching children, who understand social conditions and how to meet them, who are well versed in general hygiene, who can recognize dental disease and advise as to its treatment, and, above all, who understand the fundamental facts, so far as they are known, about oral hygiene and are able to teach them to school boards, principals, teachers, parents and children down to the kindergarten, and even to physicians and dentists. A certain amount of polishing of teeth is necessary, but in the hands of those teaching an adequate home care, it can be reduced to a minimum. The effectiveness of a prophylactic technician's cleaning and polishing the teeth of from eight to twelve children a day, each operation to be repeated in a few weeks, is slight as compared to what a properly trained worker can accomplish in examining, advising, teaching and organizing so as to bring about 100 per cent clean and healthy mouths in each school room and school.

It has been demonstrated that a corps of eight dental hygienists, properly organized, with a capable director, can organize the dental hygiene of 65,000 children in the schools. They examine them all once, with two follow-up examinations each year, and by getting the cooperation of principals, teachers and local dentists, and by the use of methods appealing to the psychology of the child and parents, they induce practically 100 per cent of the children to get their mouths cleaned up and reported healthy. A few school and charity dental clinics for the very poor supplement the work of private dentists in making this result possible. Prophylactic treatments by dental hygienists play a small part in this program.

We come to see, therefore, that the training of dental hygienists must be devoted to very different objects from those first conceived. Many graduates will still find positions in private offices and institutions as prophylactic technicians, but, from now on, the stress in educating dental hygienists must be laid on preparation for educational work in oral hygiene in the schools and institutions. Training for such educational work is much more difficult than the training of a technician in prophylaxis. She must not only have all the technical and scientific training necessary to fit here to operate on the human oral tissues, and to be of assistance in a dental office, but, above and beyond that,

she must be trained in psychology, sociology, pedagogy and public speaking, in general hygiene, and in oral hygiene in its broadest sense. She is the representative of dentistry in the schools; she is a teacher among teachers, and her preparation must be such as to place her at no disadvantage for such a position.

The result of this development in educational objectives has been to lengthen the course of training for the dental hygienist. Instead of the eight months' course originally given, the course is now two years of nine months each in Minnesota, California and Tennessee, and several of the other schools are contemplating making the change. Even two years is hardly adequate time for the cultural, pedagogic, scientific and technical training which the nature of the work demands. Two years of specialized work based on a year or two of preliminary college work would be better. This would probably have the effect, too, of attracting women of a type looking for a professional career of some years. As it is at present, the short course offers opportunity for an easy preparation for a stopgap professional career to fill the years between high school and marriage, which is the real objective of most young girls. I have no statistics but, from observation, I should say that less than three years is the average length of the professional life of the dental hygienist. Even a year of specialized university training is expensive to the state for so short a period of subsequent service. The longer course would probably pay for itself in increased length of professional life, as well as being less of a waste because of the more general education when the graduate turned to other pursuits. Educational work in oral hygiene in the schools is sufficiently dignified and pays well enough to attract women even if three or four years of college training was required. An increase in requirements would temporarily decrease the supply of graduates, but the increase in service permanence of those who did graduate would go far to offset any temporary decrease in the number of graduates.

The more adequate professional training will also go far to reduce the number of dental hygienists who, by reason of immaturity, and overzeal and lack of sufficient professional contact, commit the breaches in professional ethics that have brought the ire of many dentists down on them. The trend is away from very frequent prophylactic treatment as a means of preventing dental disease. The number of those doing this work in offices is therefore not increasing greatly and will probably decrease as dentists become acquainted with modern home-care technic and its effectiveness in keeping the teeth polished. The education of dental hygienists for the future need not consider the needs of the dental office so much as formerly. Schools for dental assistants will undoubtedly develop sufficiently to care for the needs of the profession without drawing greatly on the dental hygienists. And dentists will do their own prophylactic work except in clinics, where distribution of work is financially practicable.

It is too early for any school to introduce a required pre-professional year or two of college work, no matter how nearly ideal. There will be time to discuss that when all the schools are agreed on a two year course.

The line between prophylaxis and periodontia in adults is so fine that it is impractical to draw it. Either the dentist must do his own prophylactic

work or the prophylactic technician must be trained for simple apoxesis, that is, the removal of subgingival débris and accretions. In my opinion, the dental hygienist should be so trained. Oftentimes, even children have subgingival calculus on the anterior lower teeth. According to the statutes in many states at present, she must not go beneath the gingiva to remove the accretions. Either the condition is to be neglected or the child must be referred to the dentist to do what may not take five minutes. Futhermore, the training in prophylactic technic for dental hygienists fits them far better than the average dental course does the dentists for removing subgingival calculus. Modern methods of teaching have so simplified apoxesis or root surface scaling and planing that it can be easily taught. It is much easier for the hygienist student to acquire the technic than it is for the dental student because it is a continuation of work for which she is specially trained and for which he is not. There is much to periodontia besides apoxesis. The course in the biologic sciences cannot be such for the hygienist that she could become a periodontist, but, in my opinion, she should be allowed to remove deposits on teeth to the line of periodontal attachment and should be taught to do so for children and for adults coming supposedly for prophylactic treatment only. To limit her work to tooth surfaces uncovered by the gingiva makes her work, in many instances, absurdly ineffectual, and quite needlessly so. Most dentists dislike apoxesis, and many omit it for their patients, yet refuse to sanction the dental hygienists' doing it. It is time that dentists attempting to create means for preventing dental disease in the public actually consider the public more and what might conceivably remotely affect their own pocketbooks, less. There is evil or possible evil accompanying all good. In this case, the good far outweighs the possible evil, and we should not let fear of possible evil prevent what will be positive good. I am therefore advocating (1) modification of the dental hygienist laws to permit removal of deposits on tooth surfaces beneath the gingiva where it is required in patients coming in for prophylactic care and (2) an adequate training in this technic in the dental hygienist curriculum.

With this general discussion of objectives of the dental hygienists' education out of the way, we can proceed to a study of means to accomplish the ends. Nearly everyone is agreed that the minimum preprofessional education is graduation from an accredited high school; and the majority of directors of the eleven schools for dental hygienists are agreed that the professional course should comprise at least two years. There are various suggestions as to where the course may best be given, the chief being that it should be given in the dental college, the dental dispensary, the private dental office, the normal school, the public hospital, the public schools or the technical school. In view of the high educational requirements, it would seem self-evident that the school for dental hygienists should be in close association with university education as well as with dentistry. A dental school or a dental dispensary close to a university and affiliated with it, or a normal school cooperating with a group of dentists, with a dentist in charge of the training, would seem to offer possibilities for efficient training. So much that is necessary in her education could not be obtained effectively in a private office, hospital, technical school or the public

schools, and therefore these should no longer be considered as sufficient.

The course of training should be in charge of a dental educator who is an enthusiast for oral hygiene. The actual detail of administering the school and handling the students may perhaps more economically and effectively be placed in the hands of a qualified graduate dental hygienist. If the course is given in a normal school, teachers and laboratories will need to be secured for the biologic, medical and dental subjects. The requirement is that every subject shall be taught by the course method, that is, with sufficiently prolonged contact to give real insight into the subject. The education of a dental hygienist is as important and serious in its way as that of the dental and medical students, and, as far as it goes, should be equivalent in educational value. The same principles that have been found effective in education of other professional students will apply to the hygienists. A constant check has to be kept of all courses to insure their giving value for the time spent, to insure correlation and to see that they neither overwork nor underwork the student. About fifteen credits of work per quarter or semester that require approximately forty-five hours of work a week in and outside of a class for the average student are about the proper requirement. Where more than this is given, experience shows that many women students will break down under the strain.

While the dental school in close conjunction to a university offers the ideal location for a school for dental hygienists by reason of its teachers and facilities, it is necessary to keep the students in separate classes from the dental students. They have not the same scientific preparation as the dental student, for one thing, and, for another, an intermingling creates problems in discipline which it is difficult to meet. Both groups of students do better work if separated during school hours.

Not only must there be close affiliation between the academic departments and the medicodental in the training of dental hygienists, but there should be also cooperation with hospitals, with public schools and with private dental offices in order to give training and practice in public school and hospital oral hygiene and in dental assisting.

The course should give a fair foundation in anatomy, physiologic chemistry, physiology, bacteriology, hygiene, pathology and oral anatomy, with special instruction and practice in oral hygiene, oral pathology, principles of dentistry, prophylaxis, dental laboratory, dental assisting, dental drugs, radiology and business practice. Most of these can be given the first year and they constitute the scientific and technical bases for all dental assisting and prophylactic technic. The second year can be devoted to the more advanced subjects required for workers going out in an educational capacity; namely, English, rhetoric, public speaking, psychology, sociology, pedagogy, food and nutrition, besides practice work in oral hygiene in public schools and hospitals.

Somewhere in the course, special discussion of such subjects as ethics, jurisprudence and economics as applied to dentistry and dental hygiene should be provided for. The number of hours to be devoted to each subject will vary greatly in different training schools owing to varying conditions and varying concepts. The number of subjects is so great and the time so limited that great care must be exercised that more time is not given to any subject, especially the

technical ones, than the requirements of good teaching demand. Many technical teachers, in their enthusiasm and high idealism for their subject, will desire more time than can be allowed in a well-balanced curriculum. When technical principles are acquired, rapid and skilled technic can be gained afterwards by practice. The same educational principles apply here as those proved by long struggle for dentistry.

The dental hygienists are proving their worth many times over as educational workers and prophylactic technicians in the public schools and hospitals. In private offices, their economic value is in doubt. As educational workers, they can go far to solve for dentistry the problem that is such a blot on our record; namely, the constantly mounting incidence of dental disease. Let us, by every means in our power, encourage properly qualified girls to go into the work as a life profession. Let us encourage public schools and hospitals to incorporate them into their organizations, and let us make their courses of training such that they may be a credit to the dental profession that sends them forth, that they may be able to hold their own with other educational and health workers and that they may be scientifically prepared to take the new facts, on which a preventive program can be based, as they are discovered, and use them in protecting our public from the greatest single disease scourge of our time.

RESULTS OF EIGHT YEARS OF ORAL HYGIENE IN THE PUBLIC SCHOOLS OF WEST VIRGINIA*

By G. T. EPLING, Welch, West Virginia

THE results obtained from the establishment and maintenance of a dental clinic for eight years in one county of West Virginia, on a plan never tried out before in the history of the world, has justified the permanent existence of the clinic.

While it is different from the great Rochester and Forsyth dental dispensaries, the dental clinics which have paved the way for the establishment of all dental clinics in the United States, we residents of McDowell County, West Virginia, in which the clinic referred to was established, believe that this plan can be spread throughout the world in medium-sized cities, small towns and rural districts with the same success that has been obtained in the eight years that this clinic has existed.

If the great clock in the Clock Tower of London should for any reason stop, the caretaker of this clock would not wait to obtain the time from some prince or potentate with a platinum or high priced watch, but should a boy happen along with an Ingersoll, would get the time, the main fact being the correct time, not from where or whom obtained. It matters not that this plan was first adopted by one county in the State of West Virginia and found a success. The main fact is that it is a success.

During my eight years' experience as director of McDowell County Den-

*Read before the Section on Mouth Hygiene, Preventive Dentistry and Public Health at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

tal Clinic and ten years' experience as director of an Industrial School Dental Clinic, from 18,000 to 28,000 children have been treated each year; and by treated, I do not mean examined, inspected or surveyed. I mean that the mouths of these school children and preschool children have been cleared of infection by the extraction of all diseased teeth which could not be treated, filled and made healthy.

I found, on inspecting the children of the schools and institutions the first time, that 97 per cent over 6 years of age are dentally defective, and that the average among preschool children under 5 years of age is 62 per cent. Dental defects are indeed the most widely prevalent and conspicuous physical defects of the children of today. Where one child needs a general or surgical operation, 200 children need a dental operation.

The past training of students in dental and medical schools has been to cure instead of prevent, but the outstanding feature of their training in the future will be to prevent instead of cure, and the prophecy of a great teacher, long since passed away, that the practice and science of medicine would some day resolve itself into a science or practice of prevention rather than cure will come true.

The fact that the prevention of dental defects begins with the expectant mother, in the embryonic state of the child's existence, has been taught by lecturers, stereoptican slides and literature since the very beginning of the dental clinic in McDowell County. Attention to her physical hygiene, body sanitation and nutrition, covering the foods containing the necessary elements to build the body of the child and repair the waste of the mother's body, is being taught in every possible way by the dentists and hygienists of the McDowell County dental clinic.

We feel that the result in reducing disease, speeding up the progress of the children through the grades in our schools and restoring the health of hundreds, has justified the amount of money it has cost the citizens who are the taxpayers and who therefore finance the clinic.

The dental clinic cares for the children of only one county. As the section is underlaid with many seams of coal, coal miners predominate.

The need of such an institution as the McDowell County Dental Clinic was demonstrated by what had been accomplished by the Jenkins Jones Dental Dispensary, established March 1, 1917, by Col. James Ellwood Jones, general manager of the Pocahontas Fuel Company for the benefit of employers' children under the age of 16 years.

McDowell County is exclusively a mining section, and its citizenship is cosmopolitan. People from every European country, Mexico and Central and South America live there. Therefore, the launching of the program that was put into effect when the county clinic was first established was attended by unusual difficulties, but likewise by unusual opportunities for worthy service. The difficulties have been surmounted; and the opportunities have been utilized.

The clinic is the only one in the world to be established by a vote of the people at a special election after the Legislature passed an enabling act authorizing that a vote be taken. The election resulted in a large majority in favor of imposing the tax to establish and maintain the dental clinic. It was necessary to make a levy of 10 cents on

each $100 property valuation the first year, and while the number of children has increased at the rate of 3,000 a year, we have reduced the tax in eight years from 10 cents to 4½ cents; or to be exact, the amount of money required to conduct the dental clinic for the year 1919, first year, was $60,000 for the work for 11,000 children, and the tax for doing the work for 22,000 children this year was only $36,400.

Every child is as much entitled to the benefits of health activities in its behalf as it is to the benefits of educational activities, as health protection is just as necessary as police, fire or property protection. We have wonderful fire fighting equipment in nearly all cities and towns, and game wardens and forest-fire fighters in all rural districts. We have paid full-time police officers in all the cities, and constables and deputies in rural districts. We build expensive concrete and rock walls around inland and seaport towns and villages to prevent the loss of life and property, all of which is paid for by the taxpayer, and usually without complaint. Millions of dollars have been appropriated by the government both federal and state, for the prevention of hog colera, chicken pip, etc. Many states of the Union have appropriated and spent thousands of dollars to wipe out disease of cattle, and I have never heard any complaints from the taxpayer for this expenditure.

It would be interesting to compare the amount of money spent for the prevention of diseases of cattle and that for the prevention of diseases of children.

There is not much achieved in the way of success unless it applies to the community at large. To select here and there a child and do its dental work does some good to a few, but does not solve the problem of preventive dentistry; and you would be surprised to know that the children of the wealthy suffer from dental defects and diseases as well as do the poor, and the work of the dental clinic is neither a charity for the poor or a luxury for the rich, but is the just due of every citizen.

The higher the social and economical development of a nation, the higher the taxes on its citizens, and the money spent by county, state or nation is returned by reducing the number of school teachers to teach repeaters, retarded and backward children, who failed to make their grades by reason of having decayed teeth and resultant diseases, and by lessening the number of inmates in all humane institutions, such as homes for incurables, asylums and reform schools.

People are no longer captivated by the big sounding reports of children examined or inspected and a report that work should be done. They want actual results. When we are contented with big reports without translating their significance into action or reducing theory to practice, we satisfy and feed ourselves simply on the fact that we have been in some big clinic or movement. We satisfy our conscience with things that count for nothing rather than testing theory by action. This fact has resulted in making such movements unpopular.

We are no longer satisfied with mere words, ideas and statistics. The people of our age do not regard disease as a penalty or consequence of sin, but believe that most diseases can be prevented better than they can be cured. The belief is growing today that a sound body generally is promotive of a sound

mind, and the health, happiness and well-being of future generations depend on getting things done, done soon and done right in order that future citizens may be sound in body and mind.

There is no institution more sacred to the American doctrine that all men are free and equal than our free school system, and the dental clinic offers each child the same opportunity to grow up with a healthy body and mind that the free school offers him to obtain an education. The McDowell County Dental Clinic not only applies to school children but to all children under 16 years of age. Therefore, it is a school and preschool clinic.

All the children of McDowell County have received the services of the dental clinic in the same spirit that they receive their teacher's services.

The failures of the dental clinics occur among those established by sporadic and philanthropic contributions, with dentists giving part of their time. Dental clinics so conducted pauperize the children accepting such service and lower their standing in the estimation of schoolmates and companions. This is sufficient reason for financing dental clinics, as stated above, by taxation. The great improvement in the health of the children, their rapid progress through the school grades, and the reduction of diseases and deformaties, with a reduction in the cost of conducting the dental clinics during eight years trial, prove beyond a doubt that the methods adopted by McDowell County could be successfully adopted by rural districts of any state in this country. McDowell County's population comes from all countries in the world and all of them accept the work of the dental clinic in an appreciative manner. I know that the same plan could be successfully worked out in any other country.

WHERE TOOTHACHE IS UNKNOWN

By JAMES J. DAVIS,† Washington, D. C.

A VISIT to the dentist holds no terrors for the children at Mooseheart. They go to the dentist as willingly and as cheerfully as they go to a "movie." As a result, Mooseheart is a community where toothache is unknown, and the children all have clean, sound teeth.

Mooseheart is a child city, complete within itself, and there the Loyal Order of Moose has assumed the responsibilities of parenthood for more than 1400 dependent orphan children of the fraternity, who are given loving care, and a home, in addition to a high school education and a trade that will enable them to take their places in the world and become self-supporting and self-respecting citizens when they graduate. The Moose do not believe in the separation of families, and whoever are left of any family after the death of the father are brought to Mooseheart as a unit. The mother may come to Mooseheart if she wishes to be near her children. The children are given every opportunity to grow up as every normal and healthy youngster should, in the refining influence of a good home.

†United States Secretary of Labor and Chairman Board of Mooseheart Governers.

Every graduate from Mooseheart goes forth ready to take his place in life and make good.

The affairs of Mooseheart are directed by a board of governors. One of the first provisions made by this board was for a modern and completely equipped dental unit at Mooseheart. Two dentists give their full time to this work, and are given a free hand in everything that will make for a healthier condition of teeth among the children.

Mooseheart: Waiting to see the dentist.

When a child arrives at Mooseheart, he is placed in a detention cottage for a short period while various examinations are made. During this time, the dentist makes a preliminary examination of the teeth, and if immediate treatment is necessary, it is given during this detention period. If not, the child does not come to the attention of the dentist again until he is taken from the detention cottage and placed in one of the home cottages. At this time, he goes again to the dentist for another examination and his first lesson in mouth hygiene. A chart is made of the patient's mouth, and is kept as a permanent record.

It has taken time to build up the great trust and faith the Mooseheart children have in their dentist. The first step in this direction was to popularize dentistry with children. This was done in various ways. Their interest was first awakened by explaining to them the necessity for clean, sound teeth, and how the teeth should be kept this way by proper eating and cleaning. They were shown how good teeth added to health and length of life.

Most boys want to be athletes, and when they understand that sound teeth are an absolute necessity for success on the athletic teams, it is easy to secure their cooperation. Teeth that are clean make a pleasing appearance, and this also appealed to them, and especially to the girls. Today, it is no uncommon sight at Mooseheart to see a child voluntarily going to the dentist and asking to have his teeth examined.

Each morning, the dentist sends to the principal of the school the names of the children wanted for examination and treatment that day, designating the hour. The children always report promptly, and this avoids confusion and delay. No child in a private home receives any better dental service than the Mooseheart children. Everything that is required to give them good teeth is supplied: gold, porcelain, crowns, bridges, and the best of dental surgery. The dental department makes a special investigation into every case. The history of the child is studied for what it may reveal regarding the dental history of the family. A dietitian prescribes the food for all the children, and plenty of food for the building and preservation of sound, strong teeth is included in this diet.

The dentist reports that of the 1400 children who come to his office, only two have ever shown any nervousness. They know that the dentist is their friend, and they trust him. On being questioned as to the method he used in gaining the complete confidence of the children, who come to his office willingly and without fear, Dr. Ghent, the chief Mooseheart dentist, says that it is not due to any special trick or strategy on his part. He went on to say, "I do not have any special methods such as the advertiser often speaks about. I use only common sense and a little child psychology. I keep in mind that my patients are children and must be reasoned with as such. They must have things explained to them in simple words. If we had the same opportunity to educate all of our American youth, we would soon have many of the prevalent diseases under control."

Orthodontia, or the straightening of deformed teeth, makes up a large part of the dental service at Mooseheart. A set of perfect teeth is rare, and in this respect, the children as they come to Mooseheart are no exception. But every effort is made to give them perfect teeth, and no expense is spared. Some of the children at Mooseheart have had their teeth moved as much as one inch. This calls for time and patience and the fullest cooperation of the child, because of the readjustment that is necessary in the bones of the mouth to give the teeth a solid setting in their new position. The dental department does everything in its power to enable the children to keep their natural teeth. No extraction is made until after a radiogram has shown that the extraction is absolutely imperative. Preventive dentistry is the general policy, as it is better for the children to acquire good habits in mouth hygiene than to spend their time having the dentist correct the injury that results from neglect of the teeth. If a child at Mooseheart is negligent in the use of the toothbrush, he is given several drills in brushing his teeth that will help him acquire the habit of brushing them regularly.

This constant dental service costs money, but it is a good investment. In many cases, the dental work done on Mooseheart children would have reached a cost of more than $1,000

if paid for at commercial rates. But it pays. Mooseheart is a community of excellent teeth. This has had much to do with the general good health and exceptionally low mortality rate at Mooseheart, which is the lowest of all communities in the world.

Take the case of Tommy Smith as an example. Tom came to Mooseheart from one of our large cities, and to date the dental work done for Tom has cost in excess of $5,000. When Tom arrived at Mooseheart, he wasn't pleasant to look at because of his misshapen face. He had what are called peg teeth. Teeth, like muscles, must be used, or they will become useless. Tom's teeth were not actually decayed when he made his first visit to the dentist, but it would not have been long before the trouble began.

The Mooseheart dentist made a thorough study of Tom. A cast was made of his mouth and shown to the Mooseheart governors. The governors were so interested in the welfare of this fatherless boy that they gave immediate instructions to do everything possible to rebuild his teeth and face. As for the cost, the dentist was told to do whatever was necessary, regardless of cost. After several conferences with dental and surgical experts, it was agreed that, while the case was most unusual, it could be relieved. A search was made into Tom's history.

Tom has two brothers and a sister at Mooseheart. They are fine looking children, with excellent teeth, and in view of this fact, it was decided that Tom could also have fine teeth. Surgical work was first done to get the bones of his mouth into their proper places. After his mouth had been reshaped, every tooth was crowned with porcelain and gold, and built to the correct size. The bite was opened a quarter inch or more. In addition to this, Tom was given a course in facial athletics, and the lines of his face are gradually being worked into their proper place to give him a natural expression. An athletic program has been worked out for Tom, covering the next four years. He will punch a bag, run short distances and take other exercises that will make him breathe deeply through his nose. This will strengthen his mouth, push his tongue to the roof of his mouth and force his jaws to spread.

If this youth had not been given the advantages of Mooseheart, in all likelihood, his teeth and mouth would never have been taken care of, owing to the prohibitive cost. When grown, he would have shunned society and become an outcast because of his misshapen features. And it would not take much of this to force him perhaps into a life of crime, thereby adding a burden to the society he shunned.

The case of Tom Smith is only one of many. Mooseheart service knows no limitations. Fathers who belong to the Moose purchase this service for their children at a cost of only 4 cents a week. Mooseheart provides a home and education for the dependent children of the fraternity until they are able to care for themselves. Mooseheart does more than that. It leaves no stone unturned to see that the children are fully equipped in every way to take their place in life and do their best. They cannot do their best unless they are in possession of sound teeth. The Mooseheart governors have made it a part of their policy to see that Mooseheart shall always be a community where toothache is unknown, and the children all have clean, sound teeth.

Medical and Dental News

Florida

Florida Dental Hygienists Organize: The Dental Hygienists Association of Florida was organized at the Florida State Dental Convention held in Daytona Beach, Oct. 28-29-30, 1926. The presiding officers for the ensuing year are: president, Hattie Lightsey, Daytona Beach; vice president, Jane Helms, Jacksonville; secretary, Josephine Caraballo, Tampa; treasurer, Bernice Chapman, Tampa.

Georgia

Dental Campaign in Athens Schools: One hundred per cent dental corrections, which has been the goal of the elementary and departmental schools in Athens, will be realized in the near future. Four schools have already announced the completion of the work, covering fillings, extractions and prophylaxis.

Illinois

Dr. Wallace Addresses Chicago Society: At a recent meeting of the Englewood branch of the Chicago Dental Society, J. Sim Wallace, London, England, spoke on "Preventive Dentistry in England and Our Debt to the Dental Profession in America." Drs. Bundesen, Black and Carlson discussed the paper.

Dr. O'Leary Addresses Chicago Society: At a recent meeting attended by nearly 300 members and guests of the Chicago Dental Society, Paul O'Leary, M.D., of the Mayo Clinic, Rochester, Minn., spoke on "Syphilis of the Mouth," illustrating his remarks with a series of excellent slides. A dinner and musical program preceded the lecture.

Indiana

State Dental Association Conference: A conference of the Indiana State Dental Association was held February 13, at the Lincoln Hotel, Indianapolis. At a breakfast which opened the meeting, J. C. Carr spoke on "Indiana Laying a Foundation for Greater Achievement." At the second session, the following papers were read and discussed: "Dentistry in Indiana, Facing 1927-1928," by Otto U. King, Chicago, General Secretary of the American Dental Association; "One of the Functions of the State Society," by C. N. Johnson, Chicago; "Educating the Practitioner," by F. R. Henshaw, Indianapolis; "An Ideal State Society Program," by R. R. Gillis, Hammond; "The 1927 Program;" Victor H. Knapp, Evansville. After a luncheon, at which those attending were the guests of the state association, the program was continued as follows: "Postgraduate Work Through the Study Club," by F. A. Hamilton, Indianapolis; "The Study Club—A Real School," by J. M. Hale, Mt. Vernon; "Planning a Section Program," by Earl Brooks; "Program for Section IV (Oral Surgery and Anesthesia) for 1928," by G. J. Pell, Indianapolis; "Program for Section VI (Orthodontia and Periodontia) for 1928," by E. L. Mitchell, Indianapolis; "The 1928 Section Officers Will Assist in Building the 1927 Program," by L. B. Spear, Indianapolis; "Building an Educational Clinic Program," by W. R. Meeker, Peru; "Selling the Annual Meeting Program," by F. B. Garner, Muncie; "How to Advertise the Meeting," by J. A. Moag; "Perfecting Plans for a Statewide Membership Drive," by C. L. Byers, Indianapolis; "How I Have Solved the Delinquency Problem," by H. T. Berkey, Fort Wayne; "How to Secure New Members in a Component Society," by A. P. McConnell, Hammond; "Financing a State Society Meeting," by W. I. McCullough, Indianapolis; "Planning and Organizing a State Dental Health Program," by Mary H. Westfall, Indianapolis; "Extent to Which Entertainment Should Be Provided and How to Finance It," by

A. R. Ross, Lafayette. A banquet was served at 6:30, the state association acting as host. After a paper on "Visualizing Our Aim—1,281 Members in 1927; 1,500 Members in 1928," by J. B. Carr, Indianapolis, a round-table conference was conducted by Otto U. King, who had charge of the program of the day. The meeting closed with a general discussion on "Evaluating the Work of This Conference."

MARYLAND

Dr. Wallace Addresses Baltimore Society: At a meeting of the Baltimore City Dental Society, Feb. 15, 1927, J. Sim Wallace, London, England, gave a paper on "Recent Medical and Dental Research on Diet and Accessory Food Factors in Relation to the Prevention of Disease of the Teeth." His paper was discussed by E. V. McCollum of the Hopkins School of Hygiene, B. Holly Smith and H. E. Kelsey of the Baltimore City Dental Society. Members of the Allegheny County, Eastern Shore, Frederick County and Washington County Dental societies, the Baltimore City Medical Society and the senior class of the Baltimore College of Dental Surgery of the University of Maryland attended.

MISSOURI

J. Sim Wallace Addresses Joint Meeting: James Sim Wallace, London, England, addressed a joint meeting of the St. Louis Dental and Medical societies, February 8, on "Medical and Dental Research on Diet and Accessory Food Factors in Their Relation to Prevention of Diseases of the Teeth."

NEW YORK

Ninth District Society Meets: The Ninth District Dental Society met, February 5, at the Hotel Belmont. After a session of the board of governors the following program was presented: "The Relation of Balancing of the Occlusion to the Other Steps in the Construction of Removable Bridgework," by L. W. Doxtater; "A Simple and Efficient Technic with Cement for the Substitution of Missing Dentine in Deep Seated Cavities, Elimination of Undercuts, and Ideal Form," by R. H. Reese; "Differential Diagnosis and Prognosis of Periodontal Disease with Special Reference to Vincent's Infection and Its Treatment," by Isador Hirschfeld, and "Anesthesia for Pulp Removal and Cavity Preparation," by F. R. Adams.

OHIO

Cleveland Clinic and Meeting: The Cleveland Dental Society presented a program of clinics and lectures, February 7, in which the following took part: P. J. Aufderheide; T. A. Bodine; R. P. Dressel, assisted by W. E. Corry; Samuel Evans; I. L. Furnas; J. Herbert Hood; R. P. Howarth; W. W. Hurst, assisted by Dr. Aufderheide; Leon E. Newman, J. M. Oelschlager, and J. A. Sweeney.

PENNSYLVANIA

Central Pennsylvania Society Meets: The Central Pennsylvania Dental Society, met, February 15-17, at Altoona. The following participated in the program: C. S. Harris, Pittsburgh, who spoke on "A New Method of Cast Gold Inlays;" Horace M. Davis, Baltimore "Extracting Simplified for the General Practitioner;" A. H. Patterson, Baltimore, "Full Upper and Partial Lower Impression;" Paul R. Stillman, New York City, "Periodontia;" C. S. Van Horn, Bloomsburg, "Considering Wax Patterns for Cast Gold Inlays;" and B. A. Courtright, Wilkes-Barre, "Root Canal Technic."

Dr. Chevalier Jackson Receives Philadelphia Award: Dr. Chevalier Jackson, professor of bronchoscopy and esophagoscopy, Jefferson Medical College, received the 1926 Philadelphia Award at a formal presentation at the Academy of Music, February 9. The award comprises a check for $10,000, a diploma and a medal. It was founded by Edward W. Bok, in 1921, in recognition of the resident who, during the preceding year, renders a service which advances the best and largest interest of Philadelphia. Addresses were made by Senator George Horton Pepper and Vice President Charles G. Dawes. Dr. Jackson presented the check to his wife, to whom he also gave much of the credit for his achievements.—*J.A.M.A.*, Feb. 19, 1927.

FOREIGN

Japan Dental Association: The Japan Dental Association has officially been established to take the place of the Japan Dental Union. The newly elected president, Professor Chiwaki, and a special committee were entrusted with making negotiations with the government concerning the new health insurance regulations. The educational department has decided to give more instruction in dental hygiene to pupils of the secondary schools.—Japan Letter, *J.A.M.A.*, Jan. 29, 1927.

Dr. A. Gysi Awarded Marcel Benoist Prize: The Marcel Benoist Prize for 1926 has been awarded to Professor Dr. A. Gysi for his work on articulation in dental prosthetics. The ceremony of presentation took place in Berne, Switzerland, on December 11th last, when the prize of Frs. 30,000 was handed to Dr. Gysi in the presence of a brilliant assemblage of scientists and notable personalities, including the President of the Swiss Confederation, several Councillors, and the French Ambassador at Berne.—*Dent. Mag.*, February, 1927.

Japan Relief Fund for Florida: According to the *Nippon-no-Shikai*, dentists and dental students in Japan are now raising a fund to aid those who suffered loss in the Florida hurricane, in appreciation for the aid rendered Japan by the United States in the earthquake and fire of 1923.

Suit Against Dentist Dismissed: A suit recently brought against S. L. Frawley of Toronto for $5,000 damages for fracture of the jaw incurred in the removal of a lower impacted third molar was dismissed on order of the court without evidence from the defendant.

General

New Dental Hygienist Journal: With the January issue, the American Dental Hygienists Association began publication of a monthly journal representing their organization. Miss Dorothy Bryant is editor.

Bill for Coordination in U. S. Health Service: A bill now before Congress authorizes the President to transfer to the public health service all or any part of any executive agency, other than agencies of the military or naval forces or the Veterans Bureau, engaged in a public activity. It would authorize details of public health officers to other executive agencies or to educational and research institutions and would create new divisions in the hygienic laboratory to study health problems.

Medical Boards Take Action Against Quacks: At the joint session of the Federation of State Medical Boards and the Council on Education, Licensure and Hospitals of the American Medical Association, held recently in Chicago, officialdom and the profession pledged themselves to "wipe out quackery and charlatanry in the healing arts." A motion was carried providing that the president of the National Federation of State Medical Board shall appoint committees to direct the crusade to circulate information, to devise remedies and to prepare methods for the nationwide interchange of facts concerning the operation of offenders, some of whom operate from state to state. The aid of governors of states, of legislatures and of courts will be enlisted. Annual registration of physicians, as required in New York State, was described as a useful measure in bringing to light and eliminating illegal practitioners.

J. Butler Wright Appointed Envoy: J. Butler Wright of Wyoming, assistant secretary of state, who represented the government at the opening of the Seventh International Dental Congress, was recently appointed envoy to Hungary.

Army

Graduation, Army Medical Center: Following are the graduates of the dental school at the Army medical center, in this city, (Washington, D. C.), January 31: Honor Graduates—Capt. George R. Kennebeck, (dental corps medal). 1st Lieut. Hugh D. Phillips. Graduates—Capts. Joseph L. Boyd, Warren C. Caldwell, Beverley M. Epes, Claude R. Hollister and Gregorio G. Alona (D. C. Res.) 1st Lieuts. Arthur L. Irons, Marvin E. Kennebeck and Frank E. Patterson.—*Army and Navy Register*, Feb. 12, 1927.

Dental Corps Examination: Announcement has been made by the War Department that an examination of applicants for appointment as first lieutenants in the dental corps of the Regular Army, under the provisions of the Army Regulations 605-15, will be held within the continental limits of the United States from May 16 to 21, 1927, inclusive.

At the present time there are two vacancies among the commissioned personnel of the dental corps, there being 158 commissioned officers authorized for this corps in the medical department. The War Department has designated four boards of officers to convene for the purpose of examining the applicants and will meet at the following places: Walter Reed General Hospital, Washington, D. C.; Letterman General Hospital, San Francisco, Calif.; Fitzsimons General Hospital, Denver, Colo., and the station hospital at Fort Sam Houston, Texas.—*Army and Navy Register*, Feb. 26, 1927.

Dental Corps: The following relieved assignment and duty as indicated, ordered students, Army dental school, beginning August 23:

Maj. E. L. Hering, Fort Monroe; Capt. L. H. Tingay, Fort Clark; Capt. R. F. Thompson, Fort Bliss; Capt. T. J. Cassidy, Fort Thomas; Capt. T. M. Page, Fort McPherson; Capt. T. L. Spoon, Fort Bragg; Capt. H. J. Lambert, Edgewood Arsenal.

Capt. J. J. Weeks, granted two months and fifteen days' leave from March 1.—*Army and Navy Register.*

Three Million Deafened School Children in the United States: The extent of deafness discovered in recent surveys among the children of New York State indicates that there are more than 3,000,000 hard-of-hearing children in the United States. It therefore seems important that all children should be tested for hearing, and a method has been devised, through the use of a phonograph and individual telephones, by which 40 children may be examined at a time.—*Bull. U. S. Dept. Labor.*

Deaths

Bliler, Harry E., Chicago, Ill.; Northwestern University Dental School, 1889; died, March 3, of heart disease.

Boyd, Charles T., Columbus, Ohio; Ohio State University, College of Dentistry, 1915; died, January 17.

Eisenstaedt, Moses, Chicago, Ill.; Northwestern University Dental School, 1900; died, February 26.

Latham, James O., Columbus, Ohio; Ohio Medical University, College of Dentistry, 1900; died, March 2, of heart disease; aged 50 years. Dr. Latham practiced in Columbus for twenty-nine years.

Smith, Albert S., Oswego, N. Y.; died. December 18; aged 87. Dr. Smith practiced in Oswego for fifty years.

Smith, John H., Worcester, Mass.; Pennsylvania College of Dental Surgery, 1903; died, December 22, after a long illness; aged 57.

Van Ness, Ward M., Bridgeport, Conn.; The Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1906; died January 4, in his office, of heart disease.

Van Wickle, Orville, Matawan, N. J.; New York College of Dentistry, 1892; died, November 21, from heart disease; aged 70.

Wilkes, Charles O., Ripley, Tenn.; University of Tennessee, College of Dentistry, 1916; died, December 1, of typhoid fever; aged 32. Dr. Wilkes, who was a veteran of the World War, is survived by a wife, son and daughter.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Need of Teaching Medical Ethics: The medical student and the practitioner of medicine should be taught that when he undertakes the treatment of a patient he makes a contract with the patient, that is legally binding, to give the patient the benefit of the knowledge possessed by the "professors" (the men who profess to be medical men) of the science and art of medicine in the place and at the time the services are rendered. It is, therefore, part of sound medical ethics for the physician to make himself competent. He is also bound to give his patient the benefit of good judgment, and sound medical ethics requires that in his dealings with his patient he must be governed by the Golden Rule. He should never do an operation on a patient which he would not want to have done on himself under the same circumstances. The three absolutely essential requirements of the medical man are honesty, good judgment and scientific training; and the greatest of these is honesty. These facts should be recognized by both the profession and the public. . . . When I began to practice surgery, "division of fees" was unknown. I never heard of it until about 1898. In the copy of the "Code of Ethics" of the American Medical Association printed in 1901, division of fees is not mentioned. It has been vigorously attacked by the American Medical Association and by the American College of Surgeons, and I believe that the evil is diminishing. It is, however, still a common practice in some localities and should be eliminated by drastic measures. It is a matter which from the standpoint of either medical or general ethics is not open to argument. The medical man who deceives his patients by some scheme of division of fees might just as well pick his patient's pockets. This practice should be done away with by the teaching of sound medical ethics.—Arthur Dean Bevan, in *J.A.M.A.*, Feb. 26, 1927.

Classification of Oral Tumors: A classification of oral tumors is suggested by Carl W. Waldron (*Am. J. Surg.*, December, 1926), in an effort to obviate the confusion arising from the varied classifications appearing in textbooks on general and oral pathology and oral surgery and in published case reports. The author says: "Tumors are best classified on a histologic basis. This will also conform to the more gross classification from the standpoint of the embryonic layer from which the cells are derived. Such a classification should be well subdivided in order to avoid crowding and confusion in terminology. Essentially a histologic classification, it should be considered in the light of a reference index or dictionary of tumors to be used as a basis for the study and classification of those of special interest to our field." The looseness of the application of the term "mixed tumors" is deplored, except in the cases of neoplasms of the salivary glands, palate, etc., kidneys and testes in which a variety of cell structures is shown, and it is suggested that a new name be sought for that group of tumors arising in the salivary glands, palate, face, etc. A purely pathologic classification of tumors has its limitations with reference to its clinical and topographic application and a special classification based on clinical, surgical and pathologic considerations is necessary in almost every field of surgery. Surgical classifications have not been made to conform to those of the pathologists. The author suggests, as the large divisions of tumors the following: connective tissue tumors, angioblastoma, myoblastoma, tumors of the blood-forming tissues, melanoblastoma, tumors of nervous tissue, epithelial tumors, mixed tumors and teratoma. A list of the subdivisions of these groups is given, as well as a complete tabulation of bone tumors. Odontomes are classified, and described, under dental root cysts, dentigerous cysts, adamantinoma or multilocular cysts,

fibrous odontomes, cementomas and composite or hard odontomes. The author concludes: "In connection with carcinoma of the oral cavity, it would seem desirable from a clinical and prognostic standpoint, to grade the tumors on the basis of cell differentiation and malignancy."

Mental Senility: Luckily for the race and for society in general, the human brain preserves its vigor and acuteness for a long period of time, even after senescence has stamped its progress on many other tissues and organs. But to possess a vigorous brain, there must be constant exercise of the mental faculties, of the reasoning powers, and a grappling with new ideas and new problems; a kind of mental gymnastics, indeed, which must be practiced if the brain is to remain facile, and able to adapt itself surely and accurately to changing circumstances. Unfortunately, the tendency of old age is toward a loss of this mental agility. One easily finds himself in mental ruts if his thinking faculties take no new excursions into new fields. The old ways are easier, no doubt; new lines of thought demand effort, and disinclination to effort is one of the signs of old age. To be mentally alert, therefore, requires deliberate effort to attain the desired goal. A youthful attitude of mind is one of the most desirable possessions. This may be cultivated, but it is a life long process, and comes only from an habitual state of openmindedness. If the inappropriate term of "cerebral ossification" may be employed, the idea is well expressed thereby. All of us have noted this mental senescence among our friends and acquaintances, if not in ourselves. The disinclination to keep abreast of the times, to grasp new ideas, to try new methods, is a fatal symptom of this "ossification."—Editorial, *Arch. Phys. Therap., X-Ray, Rad.*, January, 1927.

Case of Trigeminal Neuralgia: A case is reported by Morris and Webb (*Brit. Dent. J.*, Jan. 15, 1927) in which the patient, a man, aged 50, complained of an acute spasmodic pain starting in the gum over the alveolar area of the upper right central incisor, shooting upward to the right infra-orbital foramen. The pain commenced on the touching of a certain area on the lip, on light pressure applied to the moustache, and on pressure over the alveolus, and caused lachrymation. The pain had begun after extraction of the teeth, eighteen months previously. The gums appeared healthy and the antrum and accessory sinuses were clear and the eyes normal. Antineuralgia treatment, including ultraviolet radiation, was given, with little success. Radiographic examination showed an area of rarefaction and what appeared to be a spicule of dead bone in the right upper central region. Operation disclosed what appeared to be the remains of a dental cyst. This was scraped and the soft bone in that area was removed. Recovery was uneventful, but there was slight, diminishing pain for six months thereafter. The authors believe that most cases of trigeminal neuralgia are due to some undiscovered focus of this type.

Eliminating Danger of Explosions from Ethylene: A method of eliminating the danger of explosions and rendering the operating room free from the unpleasant odor of the anesthetic is described by Moses Salzer (*J.A.M.A.*, Jan. 29, 1927). A small cage with a clearance on all sides of about one-eighth inch and equipped with a slip joint to which a hose of not less than three-fourths inch inside diameter can be attached is constructed around the regular McKesson expiratory valve. The thumb screw coming through the top of this valve is removed, and the spring that is attached to this screw is fastened permanently in position. The movable collar surrounding the valve is also removed. The end of the hose which is to be attached to the expiratory valve is fitted with the other half of the slip joint so that it can be readily attached to the contrivance. Any machine on the market can be modified in the same manner. The hose conducts the gases through holes in the wall to the outside.

Dental Work Among the Insane: Dental work for the inmates of the Chicago State Hospital is outlined by A. Goldstein (*Illinois M. J.*, January, 1927) as follows: A thorough examination is made of the newly admitted patient, but nothing further is done at the time unless pain is present. Those patients complaining of pain are first given attention; then those who have evidence of disease conditions, such as swelling of the jaw, and next, those patients who request service for needed work, such as fillings, extractions and prophylaxis. Fourth, attention is given to supplying restorative appliances, such as plates and bridges. This work is

usually not done unless a relative requests it and is able to pay for the actual cost of the material, as the state makes no provision for restorative work, although a small sum is available for repairing dentures that may be broken. Each patient is accompanied by an attendant when visiting the dentist. If a patient proves refractory or stubborn, the work is postponed until he is more tractable. Bedridden patients are visited on the request of the physician in charge when emergency work is to be done or pain is present. Extraction is done under local anesthesia, usually by infiltration. General anesthesia is not practiced. In the case of loose teeth, no anesthetic is given. The healing power of the patients is a cause of wonder, as they will not, in many cases, keep dirty objects and dirty hands out of the mouth. Every effort is made to teach and maintain cleanliness of the mouth as well as of the rest of the body. Cement and amalgam are used in filling. No plates or bridges are placed in epileptic cases, and little root canal work is attempted. Many of the patients are surprisingly cooperative, especially the alcoholics, maniacs and paretics. Those suffering from dementia praecox prove the worst patients.

Association of Mouth Infections, Extracted Teeth and Leukemia: Hill (*California & West. Med.*) reports a case that presented evidence of direct association of certain mouth infections with the extraction of teeth. One blood relative had died of pernicious anemia. In the preceding years, the patient's complaints had been principally gastro-intestinal, and had been due to gall-stones. At these times, he had complained of feeling "toxic." A roentgen-ray examination of his teeth disclosed apical abscesses of two inferior left molars. Because the patient considered that the teeth might have some influence on the "toxic" spells, the dentist finally persuaded him to have them extracted. This was done. The extraction was not difficult. Three days after, he felt ill, with chilly sensation, prostration and fever. There was some swelling and tenderness of the left submaxillary glands. The area of teeth extraction was swollen and bluish, and did not show any tendency to heal. A bloody purulent discharge was present. Physical examination was otherwise negative. There was neither general adenopathy nor splenic enlargement. The patient was decidedly toxic. The leukocyte count was 90,000. The urine had a trace of albumin. On the following days, the leukocytes numbered 102,000. Of these, 99 per cent were mononuclear cells and 1 per cent were polymorphonuclear cells. The number of leukocytes progressively increased to 366,000, with mononuclear cells nearly 100 per cent. The clinical course of the disease was marked by a profound toxemia, fever, prostration and delirium. The tissue in the region of the extracted teeth became gangrenous, with a foul-smelling discharge. A purpuric rash developed over the body and extremities, and anemia was marked. General adenopathy was never present nor was the spleen palpable. A terminal bronchopneumonia developed. The blood culture was negative. Death occurred after nine days' illness, and a complete necropsy was made. The clinical and pathologic diagnosis was acute leukemia, myelogenic. A second case is cited with similar sequence of events. A third patient had sciatica. Two impacted molars were removed with considerable difficulty. Six days after the extraction, a hemorrhage occurred from the right tooth socket, and this was followed by an increasing complaint of soreness of the neck and of some difficulty in swallowing. Three days after there was a rise in temperature to 100 F. The leukocyte count was 2,000. The disease ran a toxic course. The total leukocyte count progressively dropped to 200 cells. Smears from the teeth cavities and tonsils showed the organisms of Vincent's angina mixed with numerous streptococci. Death occurred fifteen days after onset of the fever, and twenty-five days after the extraction of the teeth. The diagnosis was agranulocytic angina.—Abstr. *J.A.M.A.*, Jan. 22, 1927.

Carcinoma of the Lower Jaw: After a study of 133 unselected cases, the majority of which were referred by other institutions as too far advanced for operation, Douglas Quick (*Am. J. Surg.*, December, 1926) reaches the following conclusions: 1. A combination of radium, roentgen rays and surgery offers the best means of treating epidermoid carcinoma beginning in the mucous membrane over the lower jaw. 2. Radium or radium and roentgen rays are preferable to surgery in dealing with diseases in the soft parts. The growths were of two distinct clinical types: infiltrating and papillary, the former milder appearing but much

more aggressive. A review of the cases reported led to the conclusion that cancer of the lower jaw rarely occurs in a clean mouth where the normal alkaline reaction of the saliva is retained. Infection around the teeth, retained tooth roots, ill-fitting dentures, excessive smoking and the presence of a large amount of gold work are etiologic factors in the condition. The responsibility of the dentist is indicated by the fact that 40 per cent of patients consulted a dentist first. Tissue examination is of great importance, as early diagnosis would practically reverse the end-results of treatment. In spite of the fact that surgical technic has become nearly perfect, a review of the literature indicates only from 15 to 20 per cent of cures. Infiltration of the soft parts has been the stumbling block of surgery; disease of bone has caused most of the failures in radium therapy. Therefore, it is logical to conclude that a proper combination of the two therapeutic measures would prove of most value. Radium may take care of the primary lesion, but in case it does not entirely eradicate the condition, surgery, and in a less amount than when used alone, suffices to complete the work. Radium takes care of the disease of the soft tissues and the disease of bone is left to surgery. In many cases, a combination of radium and the roentgen ray has been found to increase the amount of radiation tolerated. The cervical nodes are also treated with a combination of radiation and surgery.

Acute Osteomyelitis of the Maxilla in Infants: The site of osteomyelitis, according to frequency, is given as tibia, femur, humerus, cranial plates, mandible, terminal phalanges, maxilla, pelvis, sternum and ribs. The differential diagnosis of necrosis of the maxilla includes sequelae of dental caries, tuberculosis and syphilis, the necrosis following phosphorus poisoning and infectious fevers and the idiopathic group. Because of the similarity of observations, this condition is often reported as an empyema of the antrum of Highmore. The ages of the infants cited were 6 weeks and 7 months, and both made an uneventful recovery after the removal of sequestrums and infected tooth buds.—Tesar Vaclav, in *Cas. lék. cesk.*, abstr. *Am. J. Dis. Child.*, February, 1927.

Traumatic Occlusion and Pyorrhea Alveolaris: The theory that pyorrhea alveolaris can be overcome by prophylaxis is controverted by R. Morse Withycombe (*Dent. Sc. J. Australia*, December, 1926), who holds that without the factor of traumatic occlusion true pyorrhea alveolaris cannot exist. The benefits arising from thorough brushing comes not from the removal of the calculus but from the massaging of the gums. Salivary calculus apparently does no harm to the gingival tissues when there are no evidences of occlusal trauma. Serumal calculus, on the other hand, is entirely a product of occlusal trauma. It is usually associated with the chronic hemorrhage of bruised periodontal tissues due to traumatic occlusion. It is difficult to outline a technic for altering the cusps to assure normal function in mastication as each case has to be considered individually. The amount of force in traumatic occlusion is immaterial, the all important thing being how the force is applied. The early attention of dentists is called to the lack of natural carving of cusps by attrition during mastication and they are urged to use carborundum stones to assist judiciously where the patient has failed, and so open a way for young people to acquire the full normal exercise of the teeth during mastication. Thus stasis of the tissues, which is the forerunner of pyorrhea, will be avoided.

Roentgen-Ray Treatment of Neuralgia: Müller (*München. med. Wchnschr.*) finds that neuralgia of the trifacial nerve responds to roentgen irradiation better than any other neuralgia. Among his twenty-three patients treated during the last three years, the method failed in five, probably because of previous injection of alcohol into the nerve. Four patients improved, but could not be located later. In five patients, the neuralgia was recent. All of these recovered immediately. Among seven patients with neuralgia of longer standing, five were cured by two or three irradiations, while two had a relapse after three and four months, respectively. Good technic is the most important factor. The results obtained in sciatica were not so satisfactory.—Abstr. *J.A.M.A.*, Feb. 12, 1927.

Lengthening of Human Life: Even the common sense knowledge of exercise, sleep, fresh air and food is not yet well applied. What science is really doing is rediscovering

simple biologic living. Civilization has brought bad sanitation and now civilization, through its greatest product, science, is simply cleaning up its own mess. The invention of window glass deprived man of the ultra-violet rays and shut out the air. The death penalty resulted through tuberculosis in millions of cases. Now we have found this out and seek sunlight, natural and artificial, and invent "vita glass" and "cela glass" to let the healthful rays in again. In such ways, man has upset the equilibrium of Nature and needs to find scientific ways to restore the lost equilibrium.—Irving Fisher, in *Am. J. Pub. Health*, January, 1927.

Palliation of Inoperable Cancer: According to the author, Joseph K. Narat (*Illinois M. J.*, February, 1927), this paper is written for the purpose of emphasizing the importance of palliation of cases in which radical operation is impossible. Emphasis is placed, first, on the value of building up the resistance of the patient. Bathing in cool water is advocated on the ground that hot water causes hyperemia and thus may promote the rapid growth of an external cancer. Massage of the area of the neoplasm should be avoided lest growth be stimulated. Animal experimentation indicates that a diet rich in carbohydrates and foods containing potassium are to be avoided. Calcium retards the growth. A diet poor in proteins is to be recommended. Cooked vegetables and cereals and fruit are the best foods, and thorough mastication is important. Condiments, coffee and heavy foods, such as beans and fresh bread are to be avoided. Large quantities of water are advocated. Various sedatives and narcotics are prescribed to relieve pain. The author says: "In cancer of the oral cavity patent mouth washes should be avoided, as nearly all of them contain irritating substances such as menthol, thymol, etc. An infusion of the leaves of salvia—one tablespoonful to six ounces of water—alternating with a two per cent solution of tannic acid—serves the purpose best." External cancers should not be treated with any irritating substances such as scarlet red, silver nitrate, balsam of Peru or ichthyol. Pastes containing arsenic should be used with caution as intoxications from the absorbed arsenic have been repeatedly observed. Chromic acid causes relatively little pain and checks for a while the rapid growth. A 2 per cent aqueous solution of formaldehyd has a deodorizing quality. An application of salt paste has been recommended as palliative. Sodium chlorid destroys the cells and makes them more susceptible to irradiation. Sugar is recommended to control fetor, although the warning is given that its nutritive value may result in stimulation of the growth. Permanganate of potash or resorcin may be used for the same purpose, and the latter has analgesic and slightly antiseptic properties. Phototherapy has its use in deodorizing, and the thermocautery and carbon dioxid snow destroy necrotic masses.

What Is Behind the Deformed Face: Until we are capable of attaining the now impossible in facial restorations, the man doing this work should carefully study, recognize and give due and appropriate consideration to the patients, motives and point of view. If he does not, he is neglecting one of the most important elements in the study of the disease he assumes to treat, for the disability of this class of handicapped is due chiefly to their mental condition.—Vilray P. Blair, Soc., Proc., *J.A.M.A.*, Feb. 12, 1927.

Age at Onset of Teething: Among 278 infants recorded by Martinez Zuvira (*Arch. Lat.-Am. Pediat.*), only 41.3 per cent had teeth at the age of 6 months. The sixth month was the one in which most of the children (18 per cent) usually cut their first teeth. In 18.2 per cent of the children, the first tooth was cut after 9½ months; in 0.35 per cent, within the first fifteen days after birth. In 22.75 per cent, the upper front teeth, and in 77.25 per cent the lower front teeth were the first to appear. Early teething has little to do with nutritive conditions. A harelip baby was born with mouselike teeth. The late teething cases included three cases of mongoloid idocy (9, 12 and 16 months), and one of neuropathic diathesis (9 months). In Ferreira's hundred cases at Sao Paulo only 23 per cent of the children had teeth at 6 months. His highest figure for the eruption of the first tooth belonged to the eighth month (17 per cent). In his series, 3 per cent teethed after twelve months, as compared with 2.8 per cent in Martinez's statistics.—Abstr. *J.A.M.A.*, Feb. 26, 1927.

Announcements

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Academy of Periodontology, October 20-22, 1927, Detroit, Michigan.

American Dental Assistants Association, October 24, 1927, Detroit, Michigan.

American Dental Association, October 24-28, 1927, Detroit, Michigan.

American Medical Association, May 16-20, 1927, Washington, D. C.

American Society of Oral Surgeons and Exodontists, October 21-22, 1927, Detroit, Michigan.

American Society of Orthodontists, May 2-5, 1927, Chicago, Illinois.

American Dental Society of Europe, August 1-3, 1927, Paris.

Canadian Dental Association, May 16-19, 1927, Toronto, Canada.

International Dental Federation, August 6-9, 1927, Copenhagen.

Sixth Australian Dental Congress, August 22-27, 1927, Melbourne, Australia.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

April (1927)

Alabama, at Montgomery (12-14).
Connecticut, at New London (28-30).
Kansas, at Topeka (20-22).
Kentucky, at Louisville (5-7).
New Jersey, at Newark (27-30).
North Carolina, at Greensboro (11-13).
Oklahoma, at Oklahoma City (25-28).

May (1927)

Arkansas, at Hot Springs (9-11).
Illinois, at Peoria (10-12).
Indiana, at Indianapolis (16-19).
Iowa, at Des Moines (3-5).
Maryland, at Baltimore (2-4).
Massachusetts, at Boston (2-6).
Missouri, at St. Louis (23-26).
Nebraska, at Omaha (16-19).
New York, at Buffalo (18-20).
Pennsylvania, at Pittsburgh (10-13).
South Carolina, at Columbia (9-11).
South Dakota, at Sioux Falls (9-11).
Tennessee, at Memphis.
Texas, at Austin (10-13).
Vermont, at Burlington (25-27).
Virginia, at Virginia Beach (9-11).
West Virginia, at Martinsburg (16-18).

June (1927)

Colorado, at Colorado Springs (15-18).
Georgia, at Albany (15-17).
Maine, at Belgrade Lakes (21-23).
New Mexico, at Roswell.
Wyoming, at Thermopolis (20-21).

July (1927)

Porto Rico, at San Juan.
Wisconsin, at Milwaukee (12-14).

October (1927)

Florida, at St. Petersburg.

December (1927)

Ohio, at Cleveland (2-4).

February (1928)

Minnesota, at Minneapolis (Feb. 28-March 2).

*Announcements must be received by the ninth of the month in order to be published in the forthcoming issue of THE JOURNAL.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Connecticut, at Hartford, June 23-25, 1927. Recorder, A. B. Holmes, Waterbury, Connecticut.

Indiana, at Indianapolis, June 13, 1927. Secretary, J. M. Hale, Mt. Vernon, Indiana.

Iowa, at Iowa City, May 31-June 3, 1927. Director, H. W. Grefe.

Kansas, at Wichita, June 13, 1927. Secretary, George E. Burket, Kingman, Kansas.

Kentucky, at Louisville, June 17, 1927. Secretary, J. H. Baldwin, 908 Francis Building, Louisville, Kentucky.

Maine, at Augusta, June 23-25, 1927. Secretary, G. W. MacKay, Millinocket, Maine.

Michigan, at Ann Arbor, June 13-18, 1927. Secretary, J. W. Lyons, 617-21 Dwight Building, Jackson, Michigan.

New Jersey, at Trenton, June 27-July 1, 1927. Secretary, John W. Forsyth, 148 W. State St., Trenton, New Jersey.

North Carolina, at Raleigh, June 20, 1927. Secretary, H. O. Lineberger, Raleigh, North Carolina.

Rhode Island, at Providence, June 28-30, 1927. Secretary, Albert L. Midgley, 1108 Union Trust Building, Providence, Rhode Island.

Texas, at Dallas, June 6-9, 1927. Secretary, D. C. Johnson, Atlanta, Texas.

West Virginia, at Charleston, June 28, 1927. Secretary, C. H. Neill, 206 Professional Building, Fairmont, West Virginia.

National Association of Dental Examiners, at Detroit, Michigan, October 22, 1927. Secretary-Treasurer, George L. Powers, Memphis, Tennessee.

GEORGIA STATE DENTAL SOCIETY

The fifty-ninth annual meeting of the Georgia State Dental Society will be held, June 15-17, at Albany.

G. A. MITCHELL, *Secretary*,
Candler Bldg.,
Atlanta, Ga.

MARYLAND STATE DENTAL ASSOCIATION

The annual meeting of the Maryland State Dental Association will be held at the Belvedere Hotel, Baltimore, May 2-4, 1927. A splendid program has been arranged, and all members of the American Dental Association are cordially invited to attend the sessions.

NORVAL H. MCDONALD, *Secretary*,
304 Morris Bldg.,
Baltimore, Md.

IOWA STATE DENTAL SOCIETY

The sixty-fifth annual meeting of the Iowa State Dental Society is to be a home-coming. Ira C. Brownlie, Denver, Colo., and E. T. Tinker, Minneapolis, Minn., will lecture. James C. and Morton H. Mortonson of Milwaukee, Wis., and W. G. Crandall, Los Angeles, Calif., will conduct schools. Other clinics and schools will be given by members and former members of the society. All former Iowa men are urged to attend, and all members of the American Dental Association are invited. The dates are May 3-5, and the place of meeting the Hotel Savery, Des Moines.

CHARLES H. HENSHAW,
1112 Bankers Trust Bldg.,
Des Moines, Iowa.

NEW JERSEY STATE DENTAL SOCIETY

The fifty-seventh annual meeting of the New Jersey State Dental Society will be held, April 27-30, 1927, at the Hotel Robert Treat, Newark. The essay committee has secured V. H. Kazanjian, D.M.D., M.D., professor of clinical oral surgery, Faculty of Medicine, Harvard Medical School, who will speak on "The Treatment of Postoperative Complications of the Mouth and Jaws," and James E. Aiguier, Ph.G., D.D.S., lecturer on materia medica and physics, Dental Department, University of Pennsylvania, whose subject will be "Medicaments—Their Care, Use and Application in Everyday Dental Practice." The clinicians, to date, are: John G. Logan, Portage, Pa., who will give a clinic on "Bridgework, Platework and Inlays;" Milton Cohen, New York City, "Porcelain Restorations;" Edward F. Sullivan, Tufts Dental College, "Children's Dentistry;" Charles R. Jefferies, Jr., Wilmington, Del., "Amalgam Restorations." Other essayists and clinicians will be present and all the leading firms have already taken space in what promises to be a record convention.

MINNESOTA STATE DENTAL ASSOCIATION

The next annual meeting of the Minnesota State Dental Association will be held, Feb. 29-March 2, 1928, at Minneapolis.

R. G. KEYWOOD, *Secretary*.

NORTHERN OHIO DENTAL ASSOCIATION

The Northern Ohio Dental Association will hold its seventieth anniversary meeting, June 6-9, 1927, at the Hotel Winton, Cleveland. A scientific and educational program will be given by members of both the dental and the medical profession, known for their knowledge, skill and advanced thought. Entertainment will include golf, anniversary luncheons and a dinner to the past presidents.

E. D. PHILLIPS,
Chairman on Publicity,
2010 E. 102d St.,
Cleveland, Ohio.

PENNSYLVANIA STATE DENTAL SOCIETY

The fifty-ninth annual session of the Pennsylvania State Dental Society will be held in Pittsburgh, May 10-13. It will cater to the general practitioner of dentistry and give each man a postgraduate course on every phase of general practice, without being tiresome or verbose. The specialist in any subject will feel that the program committee had him specially in mind when they chose the speaker to present his specialty in a general way. There will be golf on Monday on a good course.

If interested write for a program. All members of the American Dental Association are cordially invited.

A. C. BARCLAY, *Recording Secretary,*
914 Highland Bldg.,
Pittsburgh, Pa.

CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet at Hartford, June 23-25, 1927, to examine applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before them. Attention of dental hygienists is called to Chap. 2907, Sec. 11, amended, of the Connecticut Dental Laws, reading as follows: "From July 1, 1926, every dental hygienist applying for a license shall present a certificate from the state board of education, that she has completed a four years' course at an approved high school, or has an equivalent academic education. No license shall be issued to any dental hygienist unless she shall present a diploma or other certificate of graduation from some reputable institution. The dental commission is authorized to determine the institutions which shall be considered 'reputable institutions' for the purpose of Chapter 153 of the General Statutes."

For further information, apply to

A. B. HOLMES, *Recorder,*
Waterbury, Conn.

INDIANA STATE BOARD OF DENTAL EXAMINERS

The Indiana State Board of Dental Examiners will hold its next examination at the State House, Indianapolis, beginning Monday morning, June 13, 1927. Applications properly executed must be in the hands of the secretary-treasurer at least one week before examinations. For further information and applications write to

J. M. HALE, *Secretary,*
Mt. Vernon, Ind.

IOWA STATE BOARD OF DENTAL EXAMINERS

The Iowa State Board of Dental Examiners will meet at the State University of Iowa College of Dentistry, Iowa City, May 31-June 3, 1927, at 9 a. m., for the purpose of examining applicants for a license to practice dentistry in Iowa. An examination for dental hygienists will be given. For further information and application blanks, address the State Department of Health, Capitol Building, Des Moines, Iowa. All papers and credentials must be filed with the department at least fifteen days prior to date of examination.

H. W. GREFE, *Director*
Examinations and Licenses.

KANSAS STATE BOARD OF DENTAL EXAMINERS

The Kansas State Board of Dental Examiners will hold their next examination at Wichita, the week of June 13, 1927. Applications should be in the hands of the secretary two weeks before the examination.

GEORGE E. BURKET, *Secretary,*
Kingman, Kan.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

The annual meeting of the Kentucky State Board of Dental Examiners, for the examination of applicants for license will be held at Louisville, June 17, 1927, commencing at 8 a. m. For blanks and detailed information, address

J. H. BALDWIN, *Secretary*,
908 Francis Bldg.,
Louisville, Ky

BOARD OF DENTAL EXAMINERS OF THE STATE OF MAINE

The Maine Board of Dental Examiners will hold an examination for registration for both dentists and oral hygienists in the city of Augusta, at the State House, June 23-25, 1927. Information, application blanks, etc., may be secured at the office of the secretary. All applications, with photograph and fee of $20, must be filed at the office of the secretary on or before June 14, 1927.

G. W. MACKAY, *Secretary*,
Millinocket, Maine.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the North Carolina State Board of Dental Examiners will be held at Raleigh, beginning promptly at 9 o'clock, June 20, 1927. For further information and application blanks, address

H. O. LINEBERGER, *Secretary*,
Raleigh, N. C.

STATE OF RHODE ISLAND BOARD OF REGISTRATION IN DENTISTRY

A meeting of the Rhode Island Board of Registration in Dentistry for the Examination of candidates will be held at the State House, Providence, Tuesday, Wednesday and Thursday, June 28-30, 1927, beginning each day at 9 a. m. Candidates shall present to the secretary of this board, at least one week before the examination, a written application on a form provided by the board, together with the examination fee of $20.00.

ALBERT L. MIDGLEY, *Secretary*,
1108 Union Trust Bldg.,
Providence, R. I.

TEXAS STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Texas State Board of Dental Examiners will be held in Dallas, June 6-9, 1927.

D. C. JOHNSON, *Secretary*,
Atlanta, Texas.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The National Association of Dental Examiners will meet, Oct. 22, 1927, at Detroit, Mich.

GEORGE L. POWERS, *Sec'y-Treas.*,
Memphis, Tenn.

CANADIAN DENTAL ASSOCIATION

The sixtieth anniversary (diamond jubilee) of the Ontario Dental Association will be held at the King Edward Hotel, Toronto, May 16-19, 1927. A cordial welcome will be extended to guests from the United States.

FRED J. CONBOY, *Sec'y-Treas.*,
Whitney Bldg.,
Toronto, Canada.

AMERICAN MEDICAL ASSOCIATION

The next annual session of the American Medical Association will be held in Washington, D. C., May 16-20, 1927.

INTERNATIONAL DENTAL FEDERATION

The International Dental Federation will be held, Aug. 6-9, 1927, at Copenhagen.

SOUTHERN ACADEMY OF PERIODONTOLOGY

The annual meeting of the Southern Academy of Periodontology will be held in Atlanta at the Atlanta Biltmore, March 16.

C. J. CARABALLO, *Secretary*,
713 Stovall Bldg.,
Tampa, Fla.

DEPARTMENT OF LITERARY RESEARCH

AMERICAN DENTAL ASSOCIATION

The American Dental Association has recognized for some time the necessity of making more readily available to members of the Association the vast amount of literature on subjects of interest to the profession. Numerous requests for the privilege of borrowing books from the Association have been received. To accommodate members and care for these requests, a new library department, offering three distinct services, has recently been organized.

PACKAGE LIBRARIES: These consist of magazine clippings, reprints, excerpts and pamphlets, presenting in one package some special phase of a subject. Each package is made up in response to a definite request and is a miniature library on that subject. Packages may be retained for one week after date of receipt. A charge of 50c for each package is to be made to cover partially the cost of assembling material. Borrowers are expected to pay return postage. Any material that has been damaged or lost is to be replaced as nearly as possible, or paid for.

BIBLIOGRAPHIES: Lists of references to books and magazine articles will also be compiled in answer to requests. A minimum charge of $1.00 will be made for ordinary service, but when very exhaustive research or extensive lists are asked for, an additional charge will be made, the estimated cost of which will be furnished. This charge is based upon the actual amount of time required to compile the bibliography. All bibliographies may be retained for your files.

CIRCULATION OF BOOKS: Books, in the library of the Association, other than bound periodicals and out-of-print editions, will be circulated for one week. Requests for book loans should be accompanied by a deposit of $2.00 for each book. This will be refunded promptly on return of the book.

As the amount of material available for loaning is necessarily limited, promptness in returning it will be greatly appreciated.

Members are urged to cooperate with the Association in getting material for the package libraries by sending in reprints of their published articles. Contributions of magazines and books would also be of great value and most welcome. If the shipment weighs under 25 pounds, send it by express, collect. If over that weight, please write us before sending.

THE DENTAL SOCIETY OF THE STATE OF NEW YORK

PRELIMINARY PROGRAM

The fifty-ninth annual meeting of the Dental Society of the State of New York will be held at the Hotel Statler, Buffalo, May 18-20, 1927. Literary exercises, clinics and exhibits will be held at the Hotel Statler. Those desiring space should communicate with Guy M. Hughey, 40 North Street, Buffalo, chairman of the exhibits committee. Harold Beier, 468 Delaware Avenue, Buffalo, is chairman of the clinic committee.

The executive committee will convene for the transaction of the business of the society, Tuesday, May 17, at 3:00 p. m., at the Hotel Statler.

Educational courses will be given, May 16-17. Application for registration should be made to J. G. Roberts, 207 E. Ferry Street, Buffalo. Full information with reference to these courses will be furnished on application. A cordial invitation is extended to the members of other state societies to avail themselves of the opportunity to take these educational courses.

LITERARY PROGRAM—May 18, 19 and 20, 1927

Research in Dental Ceramics
By Albert L. LeGro ..... Detroit, Mich.

The Fundamental Reasons for the Universal Failure to Bring About Permanent Cure of Pyorrhea
By Thomas B. Hartzell ..... Minneapolis, Minn.

Prosthetic Dentistry
By Alexander H. Patterson ..... Baltimore, Md.

The Modern Fixed Bridge, Its Construction and Application
By O. DeForest Davis ..... Minneapolis, Minn.

Operative Dentistry
By William A. Jaquette ..... Philadelphia, Pa.

Address
By Alfred C. Fones ..... Bridgeport, Conn.

EDUCATIONAL COURSES

Tooth Preparation for Gold Castings
By Charles K. Buell ..... Buffalo, N. Y.

The Scientific Removal of Teeth
A. Berger ..... New York City
Edward T. Butler ..... Buffalo, N. Y.
Henry S. Dunning ..... New York City
G. G. Pritchard ..... Buffalo, N. Y.
C. E. Rose ..... Buffalo, N. Y.

Treatment of Pulpless Teeth and Root Canal Technic
By Edouard M. Hall ..... Kansas City, Mo.

Full Denture Prosthesis
By Arthur T. Rowe ..... New York City

Partial Restorations
By J. Galvin Woodworth ..... Buffalo, N. Y.

Oral Radiography and Diagnosis
By Clarence O. Simpson ..... St. Louis, Mo.

There will be an oral health dinner at the Hotel Statler, Thursday evening, May 19. Prominent public officials are to be present, and addresses and demonstrations of the highest order will be given.

During the time of the meeting of the New York State Dental Society, sessions of the New York State dental hygienists association and the dental assistants association will be held.

Every effort is being put forth to make this meeting one of the most attractive in the history of the society. Reduced railroad rates have been secured for this meeting.

A cordial invitation is extended to all ethical practitioners. Admission to the literary meetings and clinics may be secured by registering and presenting membership cards in the state or national societies. Headquarters will be at the Hotel Statler and reservations should be made direct with the hotel management. For further information and programs, address

A. P. BURKHART, *Secretary*,
57 E. Genesee Street,
Auburn, N. Y.

MICHIGAN STATE DENTAL HYGIENISTS ASSOCIATION

The Michigan State Dental Hygienists Association will hold its annual meeting, Friday, April 22, 1927, at the Pantlind Hotel, Grand Rapids.

ESTHER F. URBANOWICZ, *Secretary*.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

The American Society of Oral Surgeons and Exodontists will meet, Oct. 21-22, 1927, at the Statler Hotel, Detroit, Mich.

FRANK W. ROUNDS, *Secretary*,
270 Commonwealth Ave.,
Boston, Mass.

THE AMERICAN ACADEMY OF PERIODONTOLOGY

The fourteenth annual meeting of the American Academy of Periodontology will be held at the Hotel Statler, Detroit, Mich., Oct. 20-22, 1927.

C. H. SCHOTT, *President*,
1004 Neave Bldg.,
Cincinnati, Ohio.

J. HERBERT HOOD,
624 Hanna Bldg.,
Cleveland, Ohio.

AMERICAN SOCIETY OF ORTHODONTISTS

(Change of dates)

The annual meeting of the American Society of Orthodontists will be held at the Edgewater Beach Hotel, Chicago, Ill., May 2-5, 1927. All members of the American Dental Association are cordially invited.

CHARLES R. BAKER, *Sec'y-Treas.*,
708 Church St.,
Chicago, Ill.

GIES TESTIMONIAL BANQUET

The New York Academy of Dentistry and Associated Local Societies will tender a testimonial banquet to Prof. William J. Gies, at the Hotel Plaza, New York City, on Tuesday evening, April 19, 1927, in recognition of the completion of the Carnegie Survey of Dental Education and the publication of the survey report. A feature of the banquet will be the presentation of dentistry's contribution to the fund for the establishment of the William J. Gies Fellowship in Biochemistry, at the Columbia University Schools of Medicine and Dentistry.

Professor Gies' six years of service in this work has already brought results of great importance to the public and our profession. Dental education has made great strides forward because of the survey, and the report prepared by Professor Gies, which is about to be issued, will give further impetus to the educational cause.

The banquet executive committee is confident that the members of the dental profession will be eager to recognize the service Professor Gies has rendered. This they can do by attending the banquet in large numbers, with their wives and daughters.

Regardless of whether you can, or cannot attend the banquet, you are invited to send a contribution to the fund to Dr. Leuman W. Waugh, treasurer, 576 Fifth Ave., New York City. The fund now amounts to $13,000, and $12,000 more is needed.

HENRY W. GILLETT, *Chairman*.

RESOLUTIONS ON THE DEATH OF DR. WHEELER

In the passing of Dr. C. W. B. Wheeler, a member of our society, we as individuals have lost a most genial associate, and the Association has lost one of its most loyal supporters since its inception.

It is, therefore, fitting that we, as members of the New York Society of Orthodontists, place on the society records, an expression of our appreciation of the high and consistent character of Dr. Wheeler as exemplified in his daily life.

Dr. Wheeler was a man of unquestioned integrity, absolute sincerity and worthiness of purpose, while, through his genial manner and disposition, his presence at our meetings was always an inspiration and his influence an assurance of careful and harmonious action.

At home and abroad, Dr. Wheeler was known as a friend of all mankind and was active in every good cause. Always constant in his devotion to duty, he never failed to carry his convictions into the actual practices of every-day life and never weakened when came the test for courage to stand by his convictions as to what he believed to be right.

Dr. Wheeler was an interested and tireless worker in our organization and only those who were closely associated with him in his service, which was always cheerfully rendered, can ever fully appreciate all that his work has meant and will continue to mean in the future.

Dr. Wheeler has gone from among us, but can never be forgotten by any member of this society who has known him, while the influence of his life and the results of his service will live on.

We cherish the remembrance of our acquaintance with Dr. Wheeler and shall continue to feel and to know, as individuals and as a society, that we are better for having known him so well. We shall hope that the acquaintance and friendship formed here may last throughout all eternity and thus be an everlasting joy.

We write no "finis" to lives like his,
For in our hearts he yet lives on.
Still with us sounds his cheery laugh,
Still close we feel his hand-clasp warm.

Times when he won he made no boast,
Times when he lost he tried again,
Gave where his help was needed most,
Played well his part in life's short game.

All all too brief the years he lived,
But fraught with good pressed down and full.
To us it falls to "carry on,"
Along the trail he helped to blaze.

GEORGE H. CADDICK,
LOURIE J. PORTER,
AUGUSTUS B. HOLT,
Necrology Committee.

Passed by the New York Society of Orthodontists, Dec. 8, 1926.

BOOK REVIEWS

Outlines of Dental Science, A New Dental Series. Published by William Wood & Co., New York.

The plan is to ultimately issue twelve volumes, five of which are already out—those on anesthestics, bacteriology, materia medica, prosthetics and radiography. There is only one of these which exceeds 200 pages, that on dental prosthetics; while one is less than 100. It will thus be seen that an earnest effort has been made to condense the various topics. Each subject has been covered by a different author, and all have brought to their work a seriousness of purpose which is commendable. Certain of the topics would have been improved by greater care in nomenclature. Such terms as "canine" for "cuspid," and "dead tooth" for "pulpless tooth" do not comport with the most recent and established usage; nor is it accurate to say that a radiographic picture shows an "abscess." The roentgen ray may demonstrate a difference in the density of bone around the root of a tooth, but it assuredly does not tell what the contents of a rarefied area may be. In future editions, we would venture to suggest a revision of some of these terms, which we feel assured would greatly improve the work.

The price of each volume is $2.50, thus bringing them within the reach of all.